

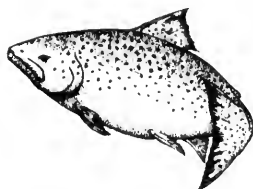
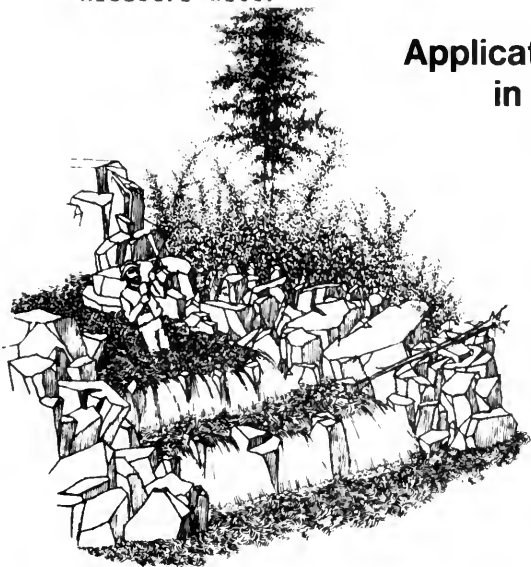
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## Application for Reservations of Water in the Missouri River Basin above Fort Peck Dam

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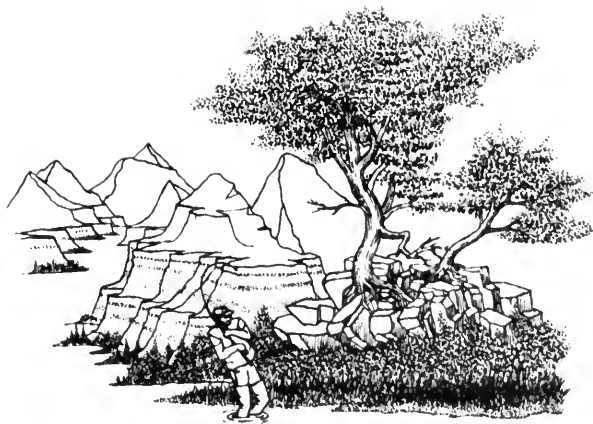
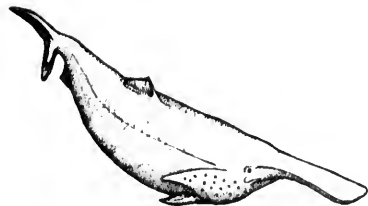
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### Volume 3

Reservation Requests for Waters  
between Canyon Ferry Dam and  
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APPLICATION FOR RESERVATIONS OF  
WATER IN THE MISSOURI RIVER BASIN  
ABOVE FORT PECK DAM

VOLUME 3

Reservation Requests for Waters  
Between Canyon Ferry Dam and  
Fort Peck Dam

Submitted by

Montana Department of Fish, Wildlife and Parks  
1420 East Sixth Avenue  
Helena, Montana 59620

June 1989

Cover sketches by Kurt Hill





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## INTRODUCTION

This is Volume 3 of a three-part application for reservations of water in the Missouri River Basin submitted to the Board of Natural Resources and Conservation. Legislation in 1985 and 1987 authorized the reservation process in the basin from the headwaters to Fort Peck Dam. This Volume covers streams in the basin from Canyon Ferry Dam to Fort Peck Dam (Figure 3-1).

Volume 3 contains information on 89 streams and two lakes (Antelope Butte Swamp and Bean Lake) for which a reservation is requested. Information presented includes a brief physical description of the water body, the fisheries and wildlife resources associated with the water, and the flow or level that is requested. The methods and data used to arrive at the requested flow are also briefly discussed. Streams are presented in a downstream order except for the two lakes which are at the end of the stream section.

Volume 1 of the application contains the Summary, Purpose, Need, Amount (including details of methods used), Public Interest Information and a Management Plan as required by ARM 36.16.104 through 36.16.106. Volume 2 is similar to Volume 3 but covers streams in the Missouri River Basin upstream from Canyon Ferry Dam.

An alphabetical index to streams and lakes in this Volume begins on page 3-iv.



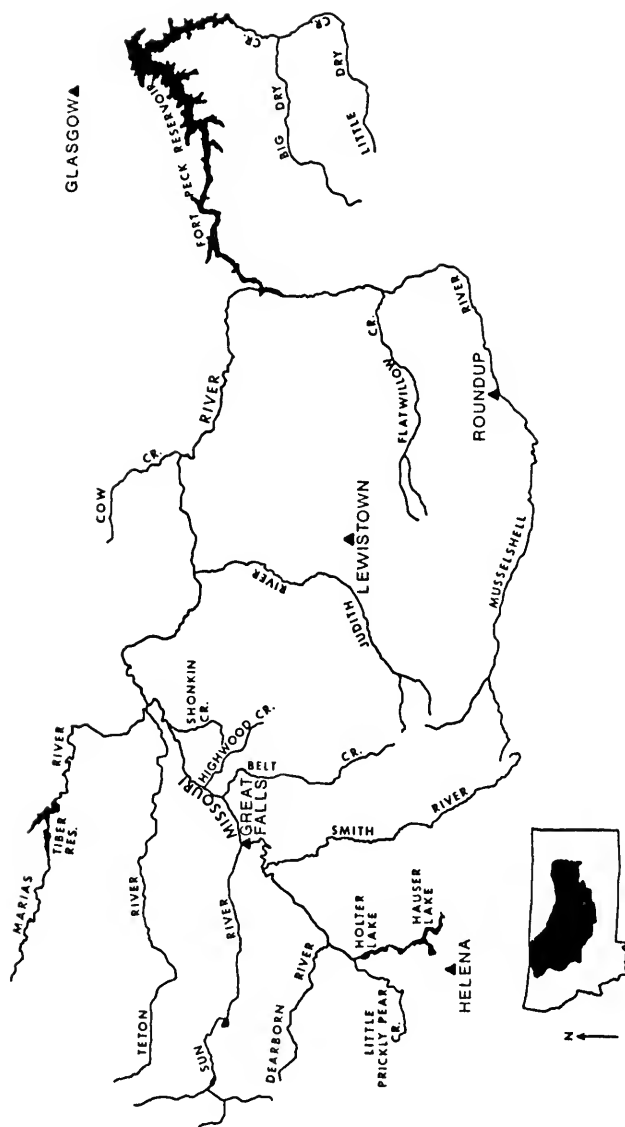


Figure 3-1. Map of the Missouri River Basin from Canyon Ferry Dam to Fort Peck Dam.



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\*<sup>1</sup> Reach 1 is contained in Volume 2.



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DESCRIPTION OF THE MISSOURI RIVER BASIN  
BETWEEN CANYON FERRY DAM AND FORT PECK DAM

This portion of the Missouri River Basin extends from Canyon Ferry Dam, located just east of Helena, to Fort Peck Dam southeast of Glasgow (see Figure 3-1).

Major tributaries entering this reach of the Missouri include: Prickly Pear Creek, Little Prickly Pear Creek, the Dearborn, Sun and Marias/Teton rivers which originate along the eastern front of the Rocky Mountains, Belt Creek and the Smith, Judith and Musselshell rivers which headwater in the isolated mountain ranges of the Big and Little Belt and Castle mountains in central Montana. Several lesser tributaries also enter this section of the Missouri from the prairie regions of the basin.

The Missouri River Basin from Canyon Ferry Dam to Fort Peck Dam drains an area of approximately 41,596 square miles or 72% of the basin upstream from Fort Peck Dam. The average stream gradient over the entire reach is about 3 feet/mile. Average daily discharge for the 52-year period of record from 1934 to 1986 at the USGS gauge located near the Fred Robinson Bridge on Highway 191 is 9,468 cfs or 6,860,000 acre-feet/year (U.S. Geological Survey 1986).

The first 150 miles of this reach are interrupted by seven dams operated by Montana Power Company as run-of-the-river hydroelectric facilities. Hauser and Holter dams are located just downstream from Canyon Ferry Dam, the remaining five dams are located in the vicinity of Great Falls. Downstream from Morony Dam, the Missouri flows uninterrupted for about 200 miles to the head of Fort Peck Reservoir. Much of this section remains essentially the same as it was when Lewis and Clark first visited it in 1805 and 1806. To protect the natural and historic integrity of this last free flowing section of the Missouri River, Congress, in 1976, designated the 149-mile section from Fort Benton to the Fred Robinson Bridge as part of the National Wild and Scenic Rivers System (U.S. Congress 1975).

Canyon Ferry Dam, located at the beginning of this reach, is a Bureau of Reclamation project completed in 1953 for irrigation, power production, flood control and recreation. Canyon Ferry Reservoir has a surface area of 35,200 acres and a storage capacity of 2,051,000 acre-feet at full pool. Releases from this project can have a major influence on the flow pattern of the Missouri River in downstream reaches.

Tiber Dam on the Marias River and Gibson Dam on the Sun River partially regulate tributary flows entering this reach of the Missouri.

This section of the Missouri River flows through three distinct geologic zones. From Canyon Ferry downstream to Sheep Creek, a distance of about 66 miles, the river flows through a confined mountain canyon along the foothills of the Big Belt Mountains. Downstream from Sheep Creek the river abruptly leaves the mountains and meanders through a wide, generally flat, foothill section above Great Falls as it enters the western edge of the Northern Great Plains. Downstream from Great Falls, and for the remainder of the reach, the river becomes entrenched within a narrow valley as it flows through the rolling plains of north-central Montana. The geology in this reach of river is dominated by rugged breaks and badlands. The surrounding plains are interrupted by several more or less isolated mountain uplifts, including the Highwood, Bearpaw, Judith and Little Belt mountains.

The river channel from Great Falls to Fort Peck is relatively young in geologic history, and the surrounding land is extremely unstable and erosive. As a result, the river flows through a relatively deep, narrow, twisting valley 500 to 1,000 feet below the average elevation of the uplifted plains. The valley bottom ranges from 1/4 to 2 miles in width. Tributary flows and geologic erosion have produced highly dissected, rough terrain, resulting in spectacular, varied and highly scenic badlands or "breaks" ranging from 2 to 10 miles in width immediately adjacent to, and along both sides of, the river valley. These breaks continue to a lesser degree up many of the tributary streams (U.S. Army Corps of Engineers and U.S. Department of Interior 1963).

Riparian vegetation from Canyon Ferry Dam through the canyon to Sheep Creek consists primarily of a narrow band of willows with scattered cottonwoods that extend along the river banks. Cottonwood woodlands become more developed in the wide floodplain areas between Sheep Creek and Great Falls. Isolated stands of cottonwoods and willows continue to occur at scattered locations along the floodplain all the way to Fort Peck Reservoir. Numerous brushy islands are also present along the entire reach. These islands support thick stands of willows, cottonwoods and rose. Scattered crop and hay lands extend to the river bank in wider sections of the valley floor. Most of these are confined to the upper part of the reach. In the breaks area below Great Falls, the floodplain is narrow and the banks are either too steep to be vegetated and are barren, or are covered with

scattered stands of juniper, pine, sagebrush, greasewood and grasses and forbs. The top of the breaks culminate in rolling uplands covered with grasses and some sagebrush. Channel substrate along the entire reach is predominantly cobble and gravel.

The climate in this portion of the Missouri Basin is semiarid and is marked by wide seasonal fluctuations in precipitation and temperature, by recurrent droughts and by a relatively short growing season. Precipitation averages about 13 inches per year.

Land ownership along the Missouri River upstream from Great Falls is almost 100% private. The Montana Department of Fish, Wildlife and Parks maintains a number of recreation and fishing access sites along this section so public access to the river is good, especially upstream from Cascade. There is a progressive increase in the amount of public land along the river downstream from Fort Benton which corresponds to the increasing ruggedness of the breaks country along the river. Most of the land along the river downstream from the mouth of the Judith River is publicly owned with the lower 35 miles above Fort Peck Reservoir flowing through the Charles M. Russell National Wildlife Refuge. The BLM maintains a rim-to-rim management corridor along approximately 108 miles of the Wild and Scenic river downstream from Coal Banks Landing. The BLM has also purchased or obtained easements on numerous historic, cultural and recreational sites along the Wild and Scenic section of river.

Access to the Missouri River downstream from Great Falls is extremely limited. Only three bridges cross the Missouri between Great Falls and Fort Peck Reservoir. Four toll-free ferries provide crossings on secondary roads during ice-free months. Numerous "jeep" or 4-wheel drive trails traverse the tops of the breaks, but access to most of these is across private land and none of them are usable during wet weather.

The entire middle Missouri River Basin is sparsely populated. The total population of the 15 counties bordering the river and its tributaries in this section of the basin is only about 195,000 persons. Great Falls is the largest city in the basin with a population of about 66,256 (U.S. Department of Commerce 1982). Other larger towns in the drainage include Helena, Lewistown, and Glasgow. There are also numerous smaller communities scattered throughout the basin.

Agriculture, including livestock grazing and hay and grain farming, provides the major economic base for the basin and is the major land use within the basin. Some logging and mining occurs in the upper reaches of many of the tributary streams. Recreation is an important industry throughout the basin providing substantial economic benefits to the region. Most of the tributary drainages as well as the mainstem Missouri River receive substantial year-around recreational use. Hunting, fishing, floating, hiking, camping, skiing and snowmobiling are some of the year-around activities. Duffield et. al. (1987) reported the annual net economic value of stream fishing alone in the Missouri River Basin between Canyon Ferry Dam and Fort Peck Dam to be \$9,549,000. This section of the Missouri River Basin provides approximately 162,000 angler-days of use per year. The 35-mile "blue ribbon" section of the Missouri River between Cascade and Holter Dam receives the second highest angler use of any stream in the state, with 72,788 angler-days per year (Duffield et. al. 1987). The Wild and Scenic section of the Missouri is very popular with floaters, and the Missouri Breaks are especially popular with hunters because of the abundance of game and the large expanses of public land.

There are approximately 334,000 acres of irrigated land in the Missouri basin between Canyon Ferry Dam and Fort Peck Dam (Montana Department of Natural Resources and Conservation 1989, personal communication from Denise DeLuca to Ken Frazer, Department of Fish, Wildlife and Parks). Most of this irrigation occurs in the tributary drainages and along the Missouri River upstream from Great Falls. Irrigation is limited along the Missouri downstream from Fort Benton because of the high valley walls, narrow river valley and poor access.

This section of the Missouri basin supports a large, diverse fish and wildlife resource. Headwater streams throughout the drainage support wild trout populations. Many streams along the eastern front of the Continental Divide and in the Big and Little Belt mountains maintain wild populations of native cutthroat trout. The wild trout fishery in the Missouri River between Canyon Ferry and Morony dams supports some of the highest angling pressure of any stream in the state. The lower reaches of the Marias, Teton and Judith Rivers, as well as the Missouri River downstream from Morony Dam, support predominately warmwater fisheries with sauger, shovelnose sturgeon, channel catfish and paddlefish providing the main sport fishing.

Most game birds and animals that occur in Montana as well as numerous non-game species are found in this section of the



Missouri basin. The headwater areas support populations of mule and white-tailed deer, elk, moose, black and grizzly bears, bighorn sheep and mountain goats. Deer and antelope are abundant throughout the prairie area with small populations of elk and bighorn sheep occurring along the Missouri River breaks. Game birds include all three species of mountain grouse, sharp-tailed and sage grouse, hungarian partridge, pheasants and turkey. Waterfowl use is also substantial throughout the basin.

This section of the Missouri River Basin provides important habitat for numerous species of raptors including the bald eagle and peregrine falcon, both listed as threatened and endangered (T&E) by state and federal agencies. Three active bald eagle nests and two historic peregrine nesting sites have been identified along the river corridor between Hauser Lake and Great Falls (Montana Natural Heritage Program<sup>1</sup>). Attempts are now underway to reintroduce peregrine falcons along this section of the Missouri River.

Numerous other T&E species are also dependent upon habitat in this section of the Missouri basin. Adult harlequin ducks with young have been observed in the upper Sun River drainage. Successful nesting of piping plover, mountain plover and least tern has been documented along Fort Peck Reservoir and in the prairie area between the river and town of Malta. Many of the tributary drainages along the eastern front of the Rocky Mountains provide critical habitat for grizzly bears.

Genetically pure populations of native westslope cutthroat trout have been identified in tributary streams draining the Eastern Rocky Mountain Front, the Big and Little Belts and the Judith mountains. These fish and those listed below are "Species of Special Concern" in Montana that are found in this section of the Missouri basin: Pallid sturgeon, paddlefish, sturgeon chub, sicklefin chub and northern redbelly dace x finescale dace hybrid (Montana Natural Heritage Program).

<sup>1</sup> Montana State Library, 1515 East Sixth Avenue, Helena, Montana 59620.

**STREAM NAME:** Missouri River

**STREAM REACH:** #2.<sup>1</sup> From Hauser Dam to Holter Reservoir -- 3.5 miles

**LOCATION:** Sec. 29, T12N, R2W to Sec. 13, T12N, R3W

**DESCRIPTION OF STREAM REACH:**

Reach #2 of the Missouri River is the free-flowing segment of the river downstream from Hauser Dam. The length of flowing river in this reach varies depending on reservoir levels and discharge, but typically extends for about 3.5 miles. The only perennial tributary entering this reach is Beaver Creek, which joins the river about 1.7 miles below Hauser Dam. Beaver Creek is approximately 17 miles long and does not contribute significant flow to the Missouri River except during spring runoff.

This reach of the Missouri River is a very popular fishing water, being entirely accessible by foot. The two primary access points for anglers are located at Hauser Dam and the mouth of Beaver Creek. Although most fishing in this reach is confined to shore, anglers also access and fish the area via motor boats. Floating in non-motorized crafts is limited due to the short length of flowing river and the lack of convenient boat launching sites. Although the majority of recreational use is attributed to fishing, other activities include hiking, camping, picnicking, hunting, and trapping. This reach flows through a high walled, rugged canyon providing significant scenic qualities.

Although Hauser Dam is operated as a run-of-the-river hydroelectric facility, flow regimens of the Missouri River in Reach #2 are not natural due to upstream regulation and storage of water in Canyon Ferry Reservoir. Flow is largely controlled by the Canyon Ferry facility, which was completed in 1953 and is operated by the U.S. Bureau of Reclamation for irrigation, hydropower, flood control, recreation, and as a supplemental water supply for the City of Helena. Hauser Dam began operation in 1911 and is owned and operated by the Montana Power Company.

Historic flows in this reach are best approximated using data from the USGS gage site immediately below Holter Dam for the period 1954 (the year Canyon Ferry began operation)

<sup>1</sup> Reach #1 is discussed in Volume 2.

to the present. Based on these gage records, the average annual flow for the post-Canyon Ferry period of record was 5,762 cfs. Mean monthly flows ranged from about 4,160 cfs (for August) to 9,270 cfs (for June).

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish, kokanee salmon, walleye

**FISHERY:**

Reach #2, although short in length, is designated as a Class I Sport Fishery by the DFWP. This reach supports one of the highest densities of rainbow trout found in Montana waters. During the fall spawning period, large numbers of trophy-sized brown trout are also present. From 1985 through 1987, three fall electrofishing estimates were conducted by the DFWP in Reach #2. The average of the totals of these three estimates showed 4,314 rainbow trout (5 inches and longer) and 355 brown trout (10 inches and longer) per mile of river.

The brown trout population is primarily adfluvial, spending much of the year in Holter Reservoir, moving into the river in the fall to spawn and then returning to the reservoir. Although rainbow trout also move in and out of the reservoir, they are more abundant than brown trout during all seasons in the flowing portion of the river. The brown trout population is entirely self-sustaining, whereas large numbers of hatchery rainbow trout stocked in Hauser and Holter Reservoirs take up residence in Reach #2. Spawning areas in this reach provide significant recruitment for both brown and rainbow trout populations. Availability of spawning habitat appears to be the main factor that regulates the brown trout population in Reach #2 and Holter Reservoir. Mountain whitefish are abundant during all seasons. Because whitefish are rarely found in Holter Reservoir, they are believed to spend their entire life span in the river. Kokanee are seasonally abundant during the fall spawning period. Much of the kokanee life history appears to take place in Holter Reservoir, with the flowing segment of river below Hauser Dam particularly important for meeting spawning requirements. Other species inhabiting the area include a few cutthroat trout, yellow perch, walleye, carp, mottled sculpin, and large numbers of white and longnose suckers.

This reach of the Missouri River is a very popular fishing water. Fishing pressure estimates conducted in 1983 indicate that 12,000 to 20,000 angler-days are expended yearly in this short river segment (McFarland 1989). Approximately 79% of the anglers reside in Lewis and Clark

County. Rainbow trout comprise 63% of the annual harvest of about 11,250 game fish, with brown trout, mountain whitefish and kokanee comprising the remainder. A few cutthroat trout, yellow perch and walleye are also taken. An average catch rate of 0.32 rainbow trout per hour is maintained.

Reach #2 is particularly noted for producing trophy brown trout during the fall spawning season, when brown trout weighing from 5 to 12 pounds are frequently taken. A few trophy rainbow trout in the 3- to 5-pound range are also caught by anglers.

#### **WILDLIFE:**

Significant wildlife values are associated with Reach #2. Beaver and muskrat are common on the river, and river otters are also present. Deer and black bear occupy the riparian zone, and elk and bighorn sheep frequent the area adjacent to the river. The area is used seasonally by waterfowl for nesting and as a resting and feeding area during periods of migration.

The ecosystem provides important feeding areas for ospreys, bald eagles, and golden eagles. Golden eagles currently nest in the canyon adjacent to the river. Peregrine falcons, recently released in the area, have a high potential for nesting and feeding along this river segment.

#### **INSTREAM FLOW METHODS:**

In the early 1980s, the Cooperative Fisheries Research Unit at Montana State University investigated, under the sponsorship of the Montana Power Company, the reproductive and rearing requirements of brown and rainbow trout in Reach #2 and predicted the impacts of altered flows from Hauser Dam on river trout populations (White et al. 1984, Carty 1985 and Spoon 1985). The study centered on evaluating the potential effects of proposed power peaking (rapidly fluctuating daily flows) at Hauser Dam on trout reproduction. In conjunction with this study, wetted perimeter data were collected by the investigators. The following narrative summarizes the minimum flow recommendations derived from this work.

### Wetted Perimeter:

Cross-sectional measurements were made in two spawning areas in Reach #2. These were located at the large gravel bar immediately below Hauser Dam (spawning area #1) and at the series of small bars one mile below the dam (spawning area #2). Four cross sections were established at each site.

Reach #2 lacks well-defined riffles. The above study sites represent some of the more riffle-like habitats within the reach.

Wetted perimeter-flow relationships were determined using the Water Surface Profile (WSP) computer program, which was calibrated to field data collected at a flow of 5,178 cfs. Additional field measurements were collected at flows of 1,986, 2,357, 2,863 and 5,048 cfs to verify the accuracy of the hydraulic predictions.

The wetted perimeter-flow relationship for the composite of eight cross sections shows an upper inflection point at an approximate flow of 3,500 cfs (Figure 3-2).

### Reproductive and Rearing Requirements:

October 15-December 15: This time period encompasses brown trout spawning in Reach #2. Study results indicated that areas suitable for spawning were limited in the reach. The most appropriate flow regime during spawning was believed by the investigators to be the one that best approximated recent historic flows (post-Canyon Ferry). A flow of 4,878 cfs was, therefore, recommended by White et al. (1984) to maintain spawning habitat for brown trout.

December 16-March 15: During this time period, which extends from the end of brown trout spawning to the start of rainbow trout spawning, the river gravel contains incubating and hatching brown trout eggs and pre-emergent fry. At a flow of 3,000 cfs, 92% of the observed brown trout redds in spawning areas #1 and #2 were covered by water. A flow of 3,000 cfs would, therefore, provide adequate conditions for egg and pre-emergent fry survival, prevent freezing of most eggs and fry, and minimize physical disturbance caused by fishermen walking on redds. At 3,000 cfs, velocities over all observed spawning sites were adequate for egg incubation.

March 16-June 30: This period encompasses rainbow trout spawning and the pre- and post-emergence of brown and rainbow trout fry. Historic flows during this period were believed to be the most appropriate flows to maintain the trout population at its present abundance and health. Mean historic flows for March-April and May-June were approximately 5,316 and 7,890 cfs, respectively [from Table 5.7-1 in White et al. (1984)].

July 1-October 14: This is an important growth period for all trout life stages and forage fish in the reach. The study provided no evidence that daily flow fluctuations between 1,500 and 9,500 cfs adversely affected the trout populations in the short-term. However, effects of altered flows on fish food organisms were not studied. Long-term impacts to trout could be severe if the food supply was negatively affected. Because the study did not derive an instream flow recommendation for this period, a flow of 3,500 cfs, the upper inflection point on the wetted perimeter-flow relationship, is requested.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout populations; to protect crucial spawning and rearing habitats for the adfluvial brown and rainbow trout populations of Holter Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

**FLOW REQUEST:**

Based on the above information, the following instream flows are requested:

<u>Period</u>	<u>Flow (cfs)</u>	<u>Acre-feet</u>	<u>Primary Purpose</u>
October 15-December 15	4,878	599,873	Maintain spawning habitat for brown trout
December 16-March 15	3,000	535,537	Maintain incubation habitat for brown trout
March 16-April 30	5,316	485,030	Maintain spawning and incubation habitats for rainbow trout
May 1-June 30	7,890	954,624	Maintain spawning and incubation habitats for rainbow trout
July 1-October 14	3,500	735,867	Maintain wetted perimeter
		<u>3,310,931 A.F./yr.</u>	

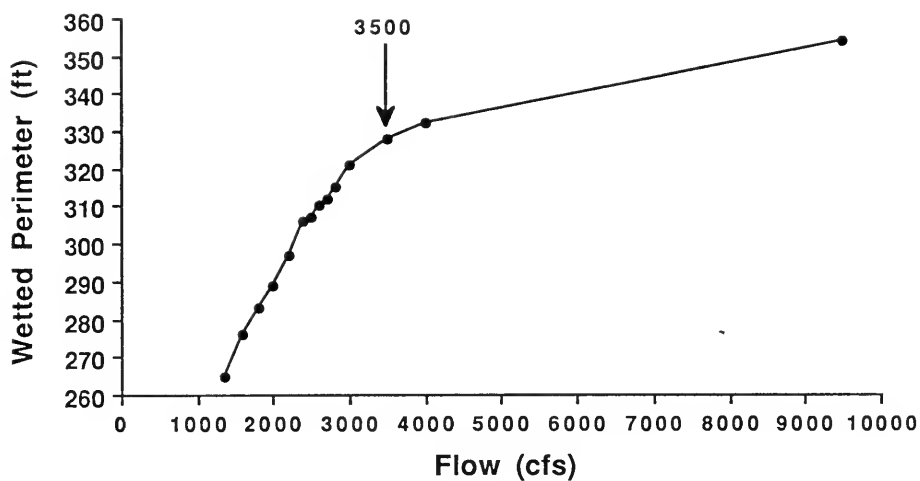


Figure 3-2. The relationship between wetted perimeter and flow for a composite of eight riffle-like cross sections in Reach 2 of the Missouri River.



**STREAM NAME:** Missouri River

**STREAM REACH:** #3. From Holter Dam to Great Falls -- 89 miles

**LOCATION:** Sec. 8, T14N, R3W to Sec. 6, T20N, R4E

**DESCRIPTION OF STREAM REACH:**

Reach #3 of the Missouri River is about 89 miles in length. Stream gradient averages only about 2 feet/mile and varies from 7.84 feet/mile at Halfbreed Rapids to 0.52 feet/mile near Ulm. The principal tributaries entering this reach are the Dearborn, Smith, and Sun rivers; Little Prickly Pear, Sheep, Rock, Stickney, Hardy, and Wegner creeks. The tributaries add considerable flow to the Missouri during spring runoff, but contribute little flow during the remainder of the year.

This section of the Missouri River is a popular and heavily utilized recreation area. A frontage road, which has officially been designated as a state Recreation Road, parallels much of the river downstream to Cascade. The river section downstream from the Wolf Creek Bridge contains eight state recreation areas and one fishing access site. From Cascade to Great Falls, there are two more fishing access sites and an additional state recreation area. From 80-90% of the existing recreational use is attributed to fishing. Floating has also become a popular sport in recent years. Other activities include picnicking, camping, trapping, and hunting.

Present day flow regimens of the Missouri River in Reach #3 are not entirely natural because of regulation and storage at several upstream dams. Flow is largely controlled by Canyon Ferry Reservoir, the largest of three consecutive upstream reservoirs. Canyon Ferry was completed in 1953 and is operated by the U.S. Bureau of Reclamation for irrigation, hydropower, flood control, recreation, and as a supplemental water supply for the City of Helena. Hauser and Holter reservoirs lie downstream from Canyon Ferry Dam and provide hydroelectric power. Hauser and Holter dams are owned and operated by the Montana Power Company.

Long-term flow records are available for two USGS gauge sites within Reach #3. For the site at the head of Reach #3 below Holter Dam, the average annual flow for a 34-year period of record was 5,579 cfs. Mean monthly flows ranged from 4,160 cfs for August to 9,270 cfs for June. The average annual flow

for a 22-year period of record for the Ulm site (9 miles downstream from the confluence of the Smith River) was 6,784 cfs. Mean monthly flows ranged from 4,730 cfs for September to 11,400 cfs for June.

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish, walleye, burbot

**FISHERY:**

The 35 miles of Reach #3 from Holter Dam to Cascade are designated a Class I Sport Fishery and support an abundance of wild rainbow and brown trout, some in the 5-10 pound trophy class. This segment is regarded as one of Montana's premier river fisheries. In the Fall of 1988, electrofishing estimates conducted by the DFWP for the river near Craig showed 4,150 rainbow trout and 466 brown trout 10 inches and longer per mile of river. At Cascade, the population declined to 930 rainbow trout and 172 brown trout per mile. Trout numbers drop markedly below Ulm where burbot and walleye become more prevalent in the fishery. However, trout still remain the dominant game fish. Other common species in Reach #3 include mountain whitefish, longnose and white suckers, carp, longnose dace, and mottled sculpin.

Fishing pressure on this reach is presently estimated at 88,400 angler-days per year (McFarland 1989). From 60-70% of these anglers reside in Cascade and Lewis and Clark counties. The bulk of the anglers fish the 35-mile segment from Holter Dam to Cascade where annual use is currently about 74,000 angler-days. Fishermen use of this segment ranks second only to the Madison River statewide. An estimated 41,800 rainbow trout, averaging 14.2 inches; 3,000 brown trout, averaging 15.0 inches; and 6,000 whitefish were harvested in 1987. An excellent overall catch rate of 0.40-0.50 rainbow trout per hour, second only to the Madison River, is maintained.

**WILDLIFE:**

Wildlife values associated with Reach #3 of the Missouri River are considerable. Sizeable beaver, muskrat, mink, and raccoon populations occur along the river. Interest in trapping is very high, especially when pelt prices are good. River otters are also present. Deer and pheasants occupy the riparian zone, and the river is used by waterfowl for nesting and as a resting and feeding area during spring and fall migrations. River islands are used extensively by nesting Canada geese.

The ecosystem provides nesting habitat for peregrine falcons, ospreys, and bald eagles. The river below Holter Dam is a wintering area for bald eagles and is also heavily used by bald eagles during spring and fall migrations. A large great blue heron rookery is located approximately 5 miles above Cascade.

## **INSTREAM FLOW METHODS:**

### Wetted Perimeter

Cross-sectional data were collected in six typical riffles of the Missouri River between Holter Dam and the confluence of the Smith River. Twenty-two riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 2,700, 3,100, 5,500, and 7,110 cfs. The upper inflection point on the wetted perimeter-flow relationship occurs at 2,900 cfs for 17 of the 22 riffles (Figures 3-3, 3-4, and 3-5). Therefore, 2,900 cfs is the flow recommended to maintain riffle wetted perimeter.

### Maintenance of Side Channels

The best method of determining instream flow needs for fish is to derive flow recommendations based on field studies of the biological requirements of key fish species. Rainbow and brown trout are the dominant game fish in the Missouri River below Holter Dam and comprise the bulk of the sport fishery.

Research studies conducted by the DFWP in 1980-81 indicated that trout, particularly brown trout, preferred side channels of the Missouri River, rather than the main channel, for spawning (Berg 1981). The preference for side channels was apparently related to the presence of more suitable depth, velocity, substrate, and adjacent cover characteristics.

In 1980, brown trout initiated spawning in side channels of the Missouri River in about mid-October. Spawning peaked in early November, and the incubation period for brown trout eggs extended through early May, when the emergence of young trout from spawning gravels was completed. Rainbow trout spawned in side channels in late March and early April and some eggs incubated until mid-May. Based on these considerations, adequate flow must be maintained in side channels for trout spawning and incubation from mid-October through mid-May.

Berg's studies further indicated that Missouri River side channels are vital for the rearing of young-of-the-year (YOY) rainbow and brown trout through about mid-October, when large

numbers of YOY begin moving from the side channels to the main river.

In summary, field studies indicated that side channels were vital year-round for trout spawning, the incubation of trout eggs, and the rearing of young.

Eleven side channels of the Missouri River between Holter Dam and the confluence of the Smith River were intensively studied in 1980 and 1981 to determine the amount of flow required to maintain suitable conditions for rainbow and brown trout spawning, incubation and rearing (Montana Department of Fish, Wildlife and Parks 1981). Trout utilization of side channels for spawning and rearing remained consistently high when flows were 4,100 cfs or higher in the Missouri River. Habitat conditions and utilization of the side channels declined precipitously when flows receded below 4,100 cfs. At a flow of 4,100 cfs, 64% of the side channels contained adequate flow for trout spawning, incubation and rearing, while at 3,600 cfs only 9% of the side channels contained adequate flow.

Thus, based on the above research, a year-round flow of 4,100 cfs is recommended to maintain suitable conditions in side channels for trout spawning, incubation and rearing.

#### Canada Goose Nesting Requirement

During the course of a 5-year inventory and planning study on the Missouri River, 629 Canada goose nests were located (Montana Department of Fish, Wildlife and Parks 1981). All nests were found on islands in the river.

Maintaining adequate flows around these islands is necessary to insure that the nests are protected from mammalian predators. Under extremely low flow conditions, predators have easy access to the islands and, through nest predation, can significantly reduce goose production. The security of the islands is a primary factor in nest site selection by geese. This security is provided by adequate side channel flows which are a function of depth, width, and velocity. A study during 1980 determined that a minimum flow of 3,550 cfs, as measured at the USGS gauge below Holter Dam, is necessary to maintain secure nesting sites in most of the typical nesting islands in Reach #3 (Montana Department of Fish, Wildlife and Parks 1981).

#### Paddlefish Migration Requirement

Reach #3 of the Missouri River is located upstream from Fort Benton, the start of the Wild and Scenic segment of the river.

The upper river is the source of much of the water for the Wild and Scenic segment. Consequently, maintaining adequate flow in Reach #3 is vital to the fishery of the Wild and Scenic segment.

Research studies indicate that paddlefish residing in Fort Peck Reservoir and the Wild and Scenic portion of the Missouri River require a flow of 14,000 cfs to initiate their annual spring migration to upstream spawning sites (Gardner and Berg 1982). Furthermore, flow should remain at or above 14,000 cfs for 48 consecutive days from May 19 through July 5, as measured at the USGS gauge station at Virgelle, Montana.

The paddlefish is officially listed as a "Species of Special Concern--Class A" in Montana, and only six major self-sustaining populations remain in the United States. For this reason, every effort should be made to preserve these ancient and unique fish through maintenance of adequate migration and spawning flows.

Based on calculations made from USGS data gathered at the Virgelle and Holter Dam gauge stations, it was determined that the Missouri River at Holter Dam contributes 45.7% of the median flow of the Missouri River at Virgelle (Montana Department of Fish, Wildlife and Parks 1981). Therefore, to maintain the annual spring paddlefish migration in the Wild and Scenic portion of the Missouri River, it is recommended that the flow of the Missouri at the Holter Dam gauge be maintained at 45.7% of 14,000 cfs, or 6,398 cfs, for 48 consecutive days from May 19 through July 5.

#### Summary of Methods

As described above, an upper inflection point flow of 2,900 cfs is required to maintain the wetted perimeter of main channel riffles in Reach #3 of the Missouri River. A flow of 4,100 cfs is required to maintain suitable conditions in side channels for trout spawning, incubation and rearing. During the goose nesting period between approximately March 15-May 31, 3,550 cfs is needed to maintain the security of island nesting sites. To help meet the spawning flow requirement of paddlefish in the Wild and Scenic segment of the Missouri River, Reach #3 must contribute about 6,398 cfs for 48 consecutive days from May 19 through July 5.

Because the flow required to maintain side channels for trout spawning, incubation and rearing (4,100 cfs) is greater than the flow requirement for goose nesting and riffle wetted perimeter, a flow of 4,100 cfs is being recommended from early July through mid-May. This flow will maintain adequate wetted

perimeter in main channel riffle areas for the production of trout food, as well as suitable conditions in side channels for nesting geese and trout spawning, incubation and rearing. From May 19 through July 5, 6,398 cfs is being recommended to help meet the spawning requirements of paddlefish in the Wild and Scenic portion of river.

**WHY FLOW IS NECESSARY:**

The requested flows are necessary to maintain the existing resident trout populations; to maintain adequate trout spawning, incubation and rearing habitats in river side channels; to maintain the security of island nesting sites of Canada geese; to help meet the spawning flow requirement of paddlefish in the Wild and Scenic portion of the Missouri River; and to help protect the habitat of the wildlife species which depend upon the stream and its associated riparian zone for food, water, and shelter.

**FLOW REQUEST:** May 19-July 5 -- 6,398 cfs ( 609,132 A.F.)  
July 6-May 18 -- 4,100 cfs (2,577,916 A.F.)

3,187,048 A.F./yr.

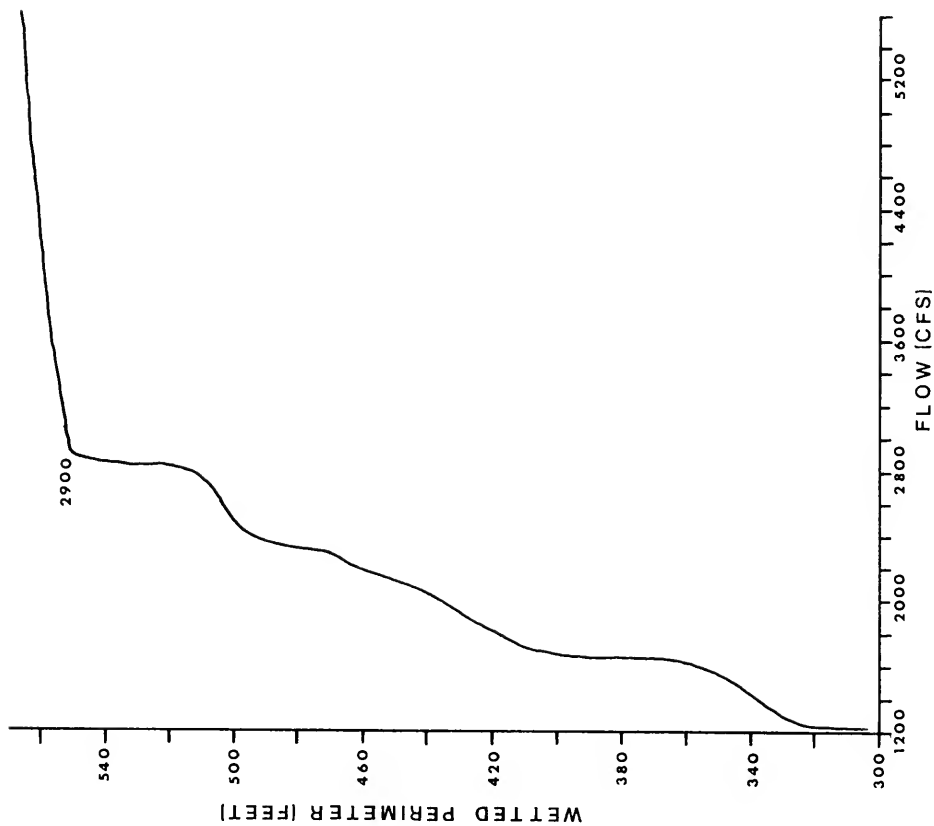


Figure 3-3. The relationship between wetted perimeter and flow for a composite of eight riffle cross sections in Reach 3 of the Missouri River.

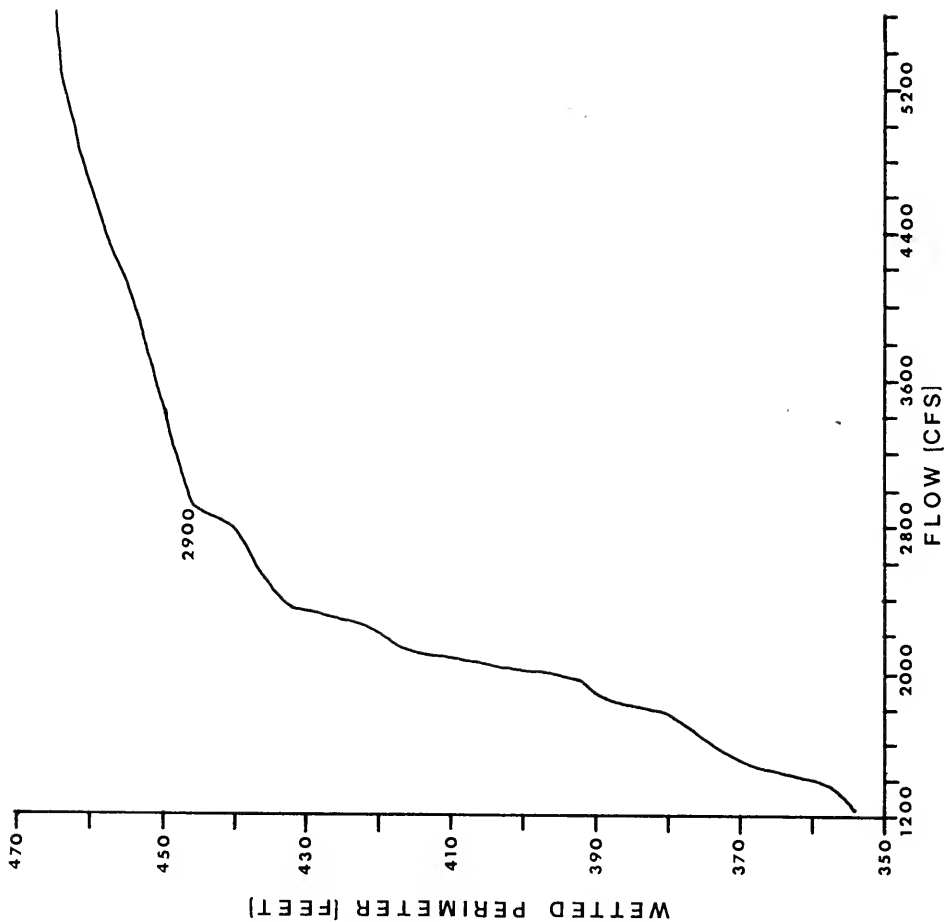


Figure 3-4. The relationship between wetted perimeter and flow for a composite of nine riffle cross sections in Reach 3 of the Missouri River.



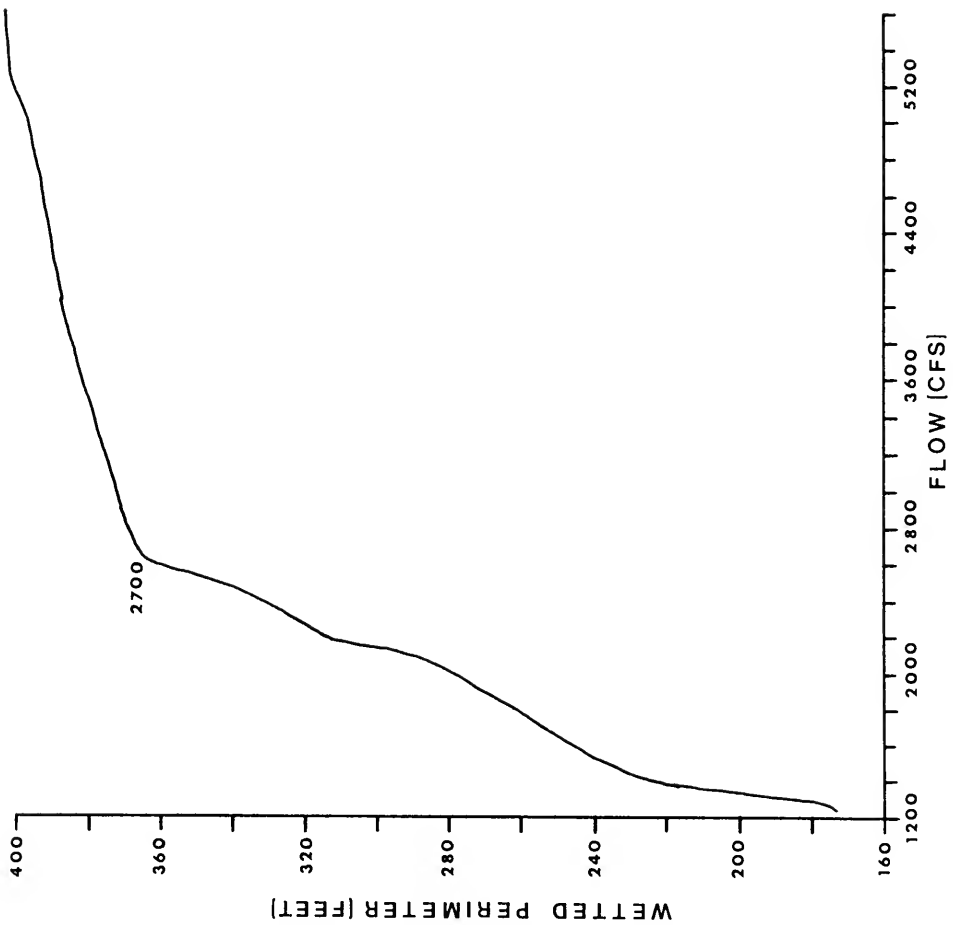


Figure 3-5. The relationship between wetted perimeter and flow for a composite of five rifle cross sections in Reach 3 of the Missouri River.

**STREAM NAME:** Missouri River

**STREAM REACH:** #4. From Great Falls to confluence with Marias River -- 54 miles

**LOCATION:** Sec. 14B, T21N, R5E to Sec. 18B, T25N, R10E

**DESCRIPTION OF STREAM REACH:**

Reach #4 of the Missouri River is 54 miles in length. Stream gradient averages 4.8 feet/mile and varies from 18.7 feet/mile at the mouth of Belt Creek to 2.2 feet/mile near the mouth of the Marias River. The principal tributaries entering this reach are Belt and Highwood creeks. Belt Creek contributes a noticeable flow to the Missouri only during the spring runoff period.

Reach #4 includes the upper 21 miles of the Upper Missouri National Wild and Scenic River which begins midway in the reach at Fort Benton. From this point, the Missouri receives heavy recreation use in spite of the lack of access points. The BLM reports that during the 5-year period, 1982-86, annual recreational use averaged 21,294 visitor-days with about 30% occurring in Reach #4 (Bureau of Land Management 1987). Nearly half of this use was in the form of recreational boating. Other activities include fishing, hunting, picnicking, camping and trapping. Access to the river is limited because of the rugged terrain and lack of development within the narrow river corridor. Two ferry crossings, plus the Morony Dam area, and the Fort Benton townsite provide public access points.

Present day flow regimens of the Missouri River in Reach #4 are not entirely natural because of regulation and storage at several upstream dams. Flow is largely controlled by Canyon Ferry Reservoir. There are five hydroelectric dams within the Great Falls area that are operated by the Montana Power Company. These dams usually do not affect streamflows except when operated in a power-peaking mode during low flow periods.

Long-term flow records are available for two USGS gauge sites within Reach #4. For the gauge site at the head of the reach below Morony Dam, the average annual flow for a 31-year period of record was 7,952 cfs. Mean monthly flows ranged from 5,100 cfs in September to 16,000 cfs in June. The average annual flow for a 97-year period of record at the Fort Benton gauge site was 5,259 cfs. Mean monthly flows range from 5,200 cfs in September to 17,000 cfs in June.

**GAME FISH PRESENT:** Sauger, mountain whitefish, walleye, brown trout, rainbow trout, burbot, shovelnose sturgeon, northern pike, channel catfish

**FISHERY:**

This reach of the Missouri River includes the transition zone between coldwater and warmwater fisheries. Sauger are by far the most abundant game fish found throughout the reach. The coldwater game fish include brown and rainbow trout and mountain whitefish. These species are fairly common only in the upper 15 miles. The remaining warmwater game fish occur in low numbers throughout this reach with the exception of walleye, which appear to be increasing in numbers over the past five years. Table 3-1 presents statistics for the game fish populations found in the study reach.

Table 3-1. Statistics of game fish populations sampled by electrofishing in the Missouri River, Morony Dam-Marias River, 1976-79.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Sauger	1,693	13.9	(7.3-23.7)	0.80	(0.09-5.29)
Mountain whitefish	158	13.8	(3.8-19.5)	1.34	(0.04-3.13)
Brown trout	35	15.8	(8.5-23.0)	1.53	(0.24-4.30)
Rainbow trout	23	12.6	(6.2-16.1)	0.78	(0.28-1.41)
Burbot	24	22.7	(14.5-26.0)	2.40	(0.75-3.85)
Walleye	19	18.1	(10.9-30.3)	3.19	(0.40-12.0)
Shovelnose sturgeon	39	34.5	(27.0-40.6)	6.86	(3.66-13.0)

Sizes of all the warmwater game fish are better than the average for river populations within the state. This is probably the result of the Missouri's productivity and the presence of suitable habitat conditions in this reach during most years.

Twenty-two non-game species have been found in this reach. A list of these species and their relative abundance is given in Table 3-2.

This reach of the Missouri is probably the most popular for warmwater angling. The statewide fishing pressure and harvest survey for 1982-86 report an average of 7,692 angler-days of use annually (McFarland 1989).

Table 3-2. Non-game species and their relative abundance in the Missouri River, Reach #4, 1976-79.

Species	Abundance
Goldeye	A
Common carp	C
Flathead chub	C
Lake chub	C
Emerald shiner	C
Western silvery minnow	C
Plains minnow	U
Fathead minnow	C
Longnose dace	A
River carpsucker	C
Blue sucker	C
Smallmouth buffalo	C
Bigmouth buffalo	C
Shorthead redhorse	A
Longnose sucker	A
White sucker	C
Mountain sucker	C
Stonecat	C
Yellow perch	U
Iowa darter	U
Freshwater drum	C
Mottled sculpin	C

A = abundant; C = common; U = uncommon; R = rare

#### WILDLIFE:

The riparian zone of the Missouri River provides prime wildlife habitat along with the isolation that is essential for many species. Excellent populations of both white-tailed and mule deer occupy the productive river bottomlands. Merriam's turkey were introduced during the early 1980s and now exist in good numbers throughout the lower portion of this reach and also in a few of the tributary drainages. Other game birds found along Reach #4 include ring-necked pheasant, sharp-tailed grouse and mourning doves. Swans, geese and several species of ducks use this section of the Missouri either during their spring and fall migrations or throughout the ice-free months. This portion of the Missouri provides some of the highest densities of nesting Canada geese found throughout the entire Missouri River system. Furbearers include large numbers of beaver, raccoon, muskrat, and mink.

## INSTREAM FLOW METHODS:

### Wetted Perimeter

Cross-sectional data were collected in seven riffles located on the river between Carter Ferry and the Marias River. The WETP program was calibrated to field data collected at flows of 4,500, 6,400, 7,500, and 10,900 cfs. The upper inflection point of the wetted perimeter-flow relationship occurs at 3,700 cfs for the composite of seven riffles (Figure 3-6). Therefore, 3,700 cfs is the flow recommended to maintain riffle wetted perimeter.

### Maintenance of Side Channels

Results of forage fish studies conducted on the Missouri River indicated that side channels are important habitat areas (Gardner and Berg 1982). Forage fish diversity and abundance were greater in the side channels compared to open river areas. Side channel areas in Reach #4 were also important rearing areas for goldeye, smallmouth buffalo and bigmouth buffalo.

Water level conditions in a side channel are related to river flow. As river flow recedes from high to low levels, the amount of suitable habitat in the side channels for forage fish and young-of-the-year fish declines. Four side channels on the Missouri River in Reach #4 were intensively studied to determine the amount of flow required to maintain suitable habitat conditions for forage fish production and for protecting rearing areas. Below a flow of 4,500 cfs, 3 of 4 side channels were in poor condition. These side channels were extremely shallow and a considerable portion of the channels became completely dewatered.

It was determined that young-of-the-year and forage fish use the side channel areas from early June through August 31. Based on this information a flow of 4,500 cfs is recommended during the period June 1-August 31 to maintain suitable conditions in side channels for rearing and forage fish production.

### Canada Goose Nesting Requirements

Considerable Canada goose nesting occurs on islands in this reach of the Missouri River. During the course of a 5-year inventory and planning study on the river from Morony Dam to Fred Robinson Bridge, 522 goose nests were located (Constan and Hook 1981).

Adequate flows must be maintained around these islands during the nesting period (March 15-June 1) to protect the nests against mammalian predators. A study during 1976-1980 determined that a minimum flow of 4,887 cfs, as measured at the USGS gauge at Fort Benton, is necessary to maintain secure nesting sites on most of the typical nesting islands in Reach #4 (Dan Hook, DFWP, personal communication to Bill Gardner, 1989).

#### Paddlefish Migration Requirement

Berg (1981) determined that paddlefish residing in Fort Peck Reservoir and the middle Missouri River require a flow of 14,000 cfs in Reach #5 to initiate their annual spring migration to upstream spawning sites. To maintain the paddlefish migration, flow should remain at or above 14,000 cfs during the 48-day period from May 19 through July 5. This time period was selected because it coincides with the biological requirements of paddlefish.

Based on calculations made from USGS data gathered at the Virgelle and Fort Benton gauge stations, it was determined the Missouri River at Fort Benton contributes 80.6% of the median flow of the Missouri River at Virgelle. Therefore, to maintain the annual spring paddlefish migration in the downstream area it is recommended that flow of the Missouri River at the Fort Benton gauge be maintained at 80.6% of 14,000 cfs, or 11,284 cfs, during the spawning period.

#### **WHY FLOW IS NECESSARY:**

The requested flows are necessary to maintain the existing resident game fish populations; to help meet the spawning flow requirement of paddlefish; to preserve the recreational values in the wild and scenic portion of the Missouri River; to maintain the security of island nesting sites for Canada geese; and to help protect the habitat of the wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

March 15-May 18; goose nesting	--	4,887 cfs ( 630,059 A.F.)
May 19-July 5; paddlefish	--	11,284 cfs (1,074,311 A.F.)
July 6-August 31; side channels	--	4,500 cfs ( 508,760 A.F.)
September 1-March 14; riffle maintenance	--	3,700 cfs (1,431,075 A.F.)

3,644,204 A.F./yr.

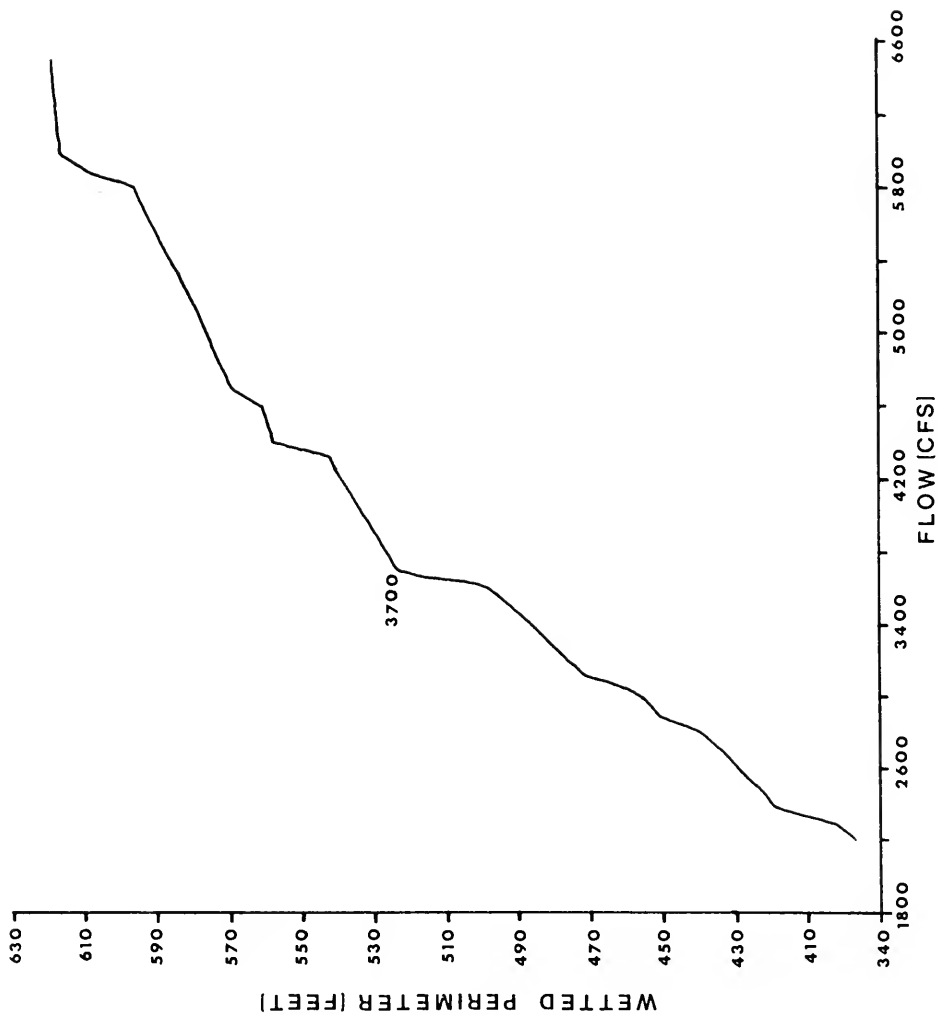


Figure 3-6. The relationship between wetted perimeter and flow for a composite of seven riffle cross sections in Reach 4 of the Missouri River.

**STREAM NAME:** Missouri River

**STREAM REACH:** #5. From the confluence of the Marias River to the confluence of the Judith River--67 miles

**LOCATION:** Sec. 18B, T25N, R10E to Sec. 26B, T23N, R16E

**DESCRIPTION OF STREAM REACH:**

Reach #5 of the Missouri River is 67 miles in length. Stream gradient averages 2.1 feet/mile and varies from 3.0 feet/mile near the mouth of Arrow Creek to 1.5 feet/mile at Coal Banks Landing. The Marias River is the only tributary stream in this reach which contributes a noticeable flow to the Missouri. During most of the year the Marias augments the Missouri River by about 10%.

All 67 miles of Reach #5 are within the Upper Missouri National Wild and Scenic River. This portion of the Missouri includes the picturesque White Rocks Canyon area which receives considerable recreational use. The BLM reports that during the 5-year period, 1982-86, annual recreational use averaged 21,294 visitor-days with about 85% occurring in Reach #5 (Bureau of Land Management 1987). Nearly half of this use was in the form of recreational boating. Other activities include fishing, hunting, picnicking, camping and trapping. About 40% of the river is bordered by BLM land. The greater portion of public land is located in the lower 30 miles of the reach. Most of the public land is difficult to reach, other than by floating, because of the rugged terrain and lack of development within the narrow river corridor. There are two ferry crossing, one bridge and two campgrounds where the public can access the river.

Present day flow regimens of Reach #5 are similar to Reach #4. The Marias does not greatly increase spring flows in the Missouri because of flood control and regulation by Tiber Reservoir.

Long-term flow records are available for the USGS Virgelle gauge station located 18 miles below the confluence of the Marias River. The average annual flow for a 52-year period of record was 8,666 cfs. Mean monthly flows ranged from 5,900 cfs in September to 20,000 cfs in June.

**GAME FISH PRESENT:** Sauger, shovelnose sturgeon, paddlefish, burbot, channel catfish, walleye



## FISHERY:

This reach of the Missouri supports a warmwater fishery. Sauger and shovelnose sturgeon are the common game fish found throughout the reach. Burbot, channel catfish and walleye probably occur in low numbers within this reach of the river. Table 3-3 lists the statistics for the game fish sampled in Reach #5.

Table 3-3. Statistics of game fish populations sampled by electrofishing in the Missouri River, Marias River to Judith Landing, 1976-79.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Sauger	570	13.0	(4.6-21.4)	0.72	(0.02-3.08)
Shovelnose sturgeon	352	32.6	(22.5-44.2)	5.17	(1.14-12.3)
Burbot	27	16.6	(9.7-28.0)	1.00	(0.18-3.90)
Channel catfish	11	23.6	(18.6-27.3)	5.79	(2.38-10.4)
Walleye	5	13.0	(10.0-16.9)	0.79	(0.26-1.21)

The shovelnose sturgeon collected here represent the maximum size found anywhere within the geographical range of the species.

Paddlefish is a game species that inhabits this reach only during its spawning season. For most of their lives, paddlefish are found in Fort Peck Reservoir. When the Missouri rises to a high flow during the spring, paddlefish leave the reservoir and migrate upstream to spawn. Paddlefish have been frequently observed as far upstream as the mouth of the Marias River. Berg (1981) identified four spawning areas in this reach. The spawning period occurs from May 19 through July 5. Because of their limited distribution and habitat requirements, the DFWP classified paddlefish as a "Species of Special Concern--Class A." This game fish receives light fishing pressure in the reach because of limited access and lack of dense paddlefish concentrations.

Twenty-two non-game species have been found in this reach of the Missouri. A list of these species and their relative abundance is given in Table 3-4. Blue sucker, smallmouth buffalo, bigmouth buffalo and freshwater drum are four non-game migratory species that are dependent on high spring flows for successful reproduction.

In addition to the paddlefish, the pallid sturgeon and sturgeon chub are two other fish residing in this segment of the Missouri with "Species of Special Concern" status. Both of these species have been sampled on less than five occasions and are considered rare throughout their entire geographical range.

Table 3-4. Non-game species and their relative abundance in the Missouri River, Reach #5, 1976-79.

Species	Abundance
Goldeye	A
Common carp	C
Flathead chub	A
Sturgeon chub	R
Lake chub	U
Emerald shiner	C
Western silvery minnow	C
Fathead minnow	C
Longnose dace	A
River carpsucker	C
Blue sucker	C
Smallmouth buffalo	C
Bigmouth buffalo	C
Shorthead redhorse	A
Longnose sucker	A
White sucker	U
Mountain sucker	R
Stonecat	C
White crappie	R
Yellow perch	U
Freshwater drum	C
Mottled sculpin	R

A = abundant; C = common; U = uncommon; R = rare

#### WILDLIFE:

The riparian zone of the Missouri River provides prime wildlife habitat along with the isolation that is essential for many wildlife species. Mule and white-tailed deer occupy the river bottomlands and wooded draws.

Ring-necked pheasant, sharp-tailed and sage grouse and mourning doves are the game birds found along this reach. The steep and rugged canyon landscape of Reach #5 is an especially important area for cliff nesting raptors such as

the golden eagle and prairie falcon. Swans, geese and several species of ducks use the Missouri during their spring and fall migrations or throughout the ice-free months. This portion of the Missouri provides good Canada goose nesting habitat. Furbearers include beaver, raccoon, muskrat and mink.

## **INSTREAM FLOW METHODS:**

### Wetted Perimeter

No riffles were surveyed for wetted perimeter modeling in Reach #5. This reach is the source of much of the water in the lower reach that starts downstream from the confluence of the Judith River. Consequently, maintaining adequate flow in Reach #5 is essential for meeting riffle maintenance requirements down river.

The flow recommended for riffle maintenance in Reach #6 is 4,700 cfs. Based on calculations made from USGS data gathered at the Robinson Bridge and Virgelle gauge stations, it was determined that the Missouri River at Virgelle contributes 91.6% of the median flow of the Missouri River at Robinson Bridge. Therefore, to maintain acceptable conditions in the riffles in Reach #6, it is recommended that the flow of the Missouri at the Virgelle gauge be maintained at 91.6% of 4,700 cfs, or 4,300 cfs. A flow of 4,300 cfs will also be beneficial for riffle maintenance in Reach #5.

### Maintenance of Side Channels

Side channels in Reach #5 are important habitat areas for forage fish production and rearing areas for goldeye, smallmouth buffalo and bigmouth buffalo. Water level conditions in a side channel are related to river flow. It was determined that a flow of 5,400 cfs is required to maintain the side channels in this reach in a suitable condition (Gardner and Berg 1982). Rearing and forage fish production occurs from early June through August 31. Based on this information, a flow of 5,400 cfs is recommended during the period of June 1-August 31 to maintain suitable conditions in side channels for rearing and forage fish production.

### Canada Goose Nesting Requirements

Considerable Canada goose nesting occurs on the Missouri River in this reach. Constan and Hook (1981) reported that an average of 38% of the total nests surveyed were in this reach. Adequate flows around the goose nesting islands are essential for protection against mammalian predators. Because the required flow for goose nesting was not specifically derived

for Reach #5, the flow recommendation was based on Reach #4's flow recommendation for goose nesting (4,887 cfs) plus the median flow accretion between reaches during the period (114%). A flow of 5,571 cfs is, therefore, recommended to meet goose nesting requirements in Reach #5.

#### Paddlefish Migration Requirement

Berg (1981) determined that paddlefish residing in Fort Peck Reservoir and the Middle Missouri River require a flow of 14,000 cfs in Reach #5 to initiate their annual spring migration to upstream spawning sites. Maintenance of the paddlefish migration is dependent on a flow at or above 14,000 cfs during the 48-day period from May 19 through July 5. This time period was selected because it coincides with the biological requirements of paddlefish.

#### **WHY FLOW IS NECESSARY:**

The requested flows are necessary to maintain the existing resident game fish populations; to help meet the spawning flow requirement of paddlefish; to preserve the recreational values in the Wild and Scenic portion of the Missouri River; to maintain the security of island nesting sites for Canada geese; and to help protect the habitat of the wildlife species that depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

March 15-May 18; goose nesting	--	5,571 cfs ( 718,244 A.F.)
May 19-July 5; paddlefish	--	14,000 cfs (1,332,892 A.F.)
July 6-August 31; side channels	--	5,400 cfs ( 610,512 A.F.)
September 1-March 14; riffle maintenance	--	4,300 cfs (1,663,140 A.F.)
		<hr/> 4,324,788 A.F./yr.

**STREAM NAME:** Missouri River

**STREAM REACH:** #6. From the confluence of the Judith River to the upper end of Fort Peck Reservoir--85 miles

**LOCATION:** Sec. 26B, T23N, R16E to Sec. 22A, T21N, R26E

**DESCRIPTION OF STREAM REACH:**

Reach #6 of the Missouri River is 85 miles in length. Stream gradient averages 1.9 feet/mile and varies from 3.2 feet/mile near Stafford Ferry to less than 1 foot/mile as the river enters the reservoir. The Judith River is the only tributary stream in this reach that contributes a noticeable flow to the Missouri. During most of the year, the Judith augments the Missouri River by about 5%. Only 62 miles of Reach #6 are within the Upper Missouri National Wild and Scenic River. This portion of the Missouri includes the rugged breaks country. There is considerable recreational use in this portion of the Missouri because of its nationally renowned beauty and wilderness qualities.

The lower 23 miles of the reach flows through the Charles M. Russell National Wildlife Refuge. Nearly all of the river in Reach #6 is bordered by land administered by the BLM or USFWS.

Most of the reach is difficult to access, other than by floating, because of the rugged terrain and large areas of roadless country. Access is limited to three bridge or ferry crossings. Only a few vehicle trails lead down to the river, with most of these being located in the lower 23 miles of river.

Present day flow regimens of the Missouri River are similar to Reach #5 and are regulated by upstream reservoirs. Long-term flow records are available for the Fred Robinson Bridge USGS gauge station located 23 miles above Fort Peck Reservoir. The average annual flow for a 53-year period of record was 9,415 cfs. Mean monthly flows range from 6,400 cfs in September to 22,000 cfs in June.

**GAME FISH PRESENT:** Sauger, shovelnose sturgeon, channel catfish, burbot, paddlefish

## FISHERY:

This reach of the Missouri River supports a warmwater fishery. Sauger, shovelnose sturgeon and channel catfish are the common game fish found throughout the reach. Tables 3-5 and 3-6 list the statistics for the more common game fish sampled in Reach #6.

Table 3-5. Statistics of game fish populations sampled by electrofishing in the Missouri River, Judith River to Fort Peck Reservoir, 1976-79.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Sauger	172	12.4	(5.1-20.5)	0.63	(0.02-2.97)
Shovelnose sturgeon	168	30.0	(23.5-38.5)	4.19	(1.12-10.08)
Burbot	10	18.6	(8.5-30.8)	1.85	(0.33-5.59)

Table 3-6. Statistics of channel catfish sampled with baited hoop nets in the Missouri River, Judith River to Fort Peck Reservoir, 1977-79.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Channel catfish	1,962	15.2	(6.9-35.9)	1.42	(0.11-23.1)

The paddlefish is another game species that inhabits this reach, but only during the spawning season. During most of their life paddlefish reside in Fort Peck Reservoir. When the river rises to a high flow during the spring, paddlefish leave the reservoir and migrate upstream to spawn. Berg (1981) identified six spawning areas in this reach. The paddlefish spawning period occurs from May 19 through July 5. Because of their limited distribution and habitat requirements, the DFWP classified paddlefish as a "Species of Special Concern--Class A." This game fish receives moderate fishing pressure in the lower 20 miles of the reach. During 1977 an estimated 1,625 anglers fished for 2,526 man-days. They snagged 900 and harvested 666 paddlefish. Most of the fishing pressure occurred over a 40-day period (Berg 1981).

Twenty-three non-game species have been found in this reach of the Missouri. A list of these species and their relative abundance is shown in Table 3-7. Blue sucker, smallmouth buffalo, bigmouth buffalo and freshwater drum are four non-game migratory species that are dependent on high spring flows for successful reproduction.

In addition to the paddlefish, the pallid sturgeon, sicklefin chub and sturgeon chub are three other species residing in this segment of the Missouri with "Species of Special Concern" status. All except the paddlefish are classified as rare throughout their entire geographical range.

Table 3-7. Non-game species and their relative abundance in the Missouri River, Reach #6, 1976-79.

Species	Abundance
Goldeye	C
Common carp	C
Flathead chub	C
Sturgeon chub	R
Sicklefin chub	U
Emerald shiner	C
Brassy minnow	R
Plains minnow	U
Western silvery minnow	C
Flathead minnow	U
Longnose dace	C
River carpsucker	C
Blue sucker	C
Smallmouth buffalo	C
Bigmouth buffalo	C
Shorthead redhorse	C
Longnose sucker	C
White sucker	R
Stonecat	C
White crappie	U
Yellow perch	U
Freshwater drum	U
Mottled sculpin	R

A = abundant; C = common; U = uncommon; R = rare

## **WILDLIFE:**

The riparian zone of the Missouri River provides prime wildlife habitat along with the isolation that is essential for many species. Bighorn sheep, elk and mule deer are closely associated with the breaks land form within the river corridor. White-tailed deer occupy the river bottomlands and wooded draws.

Sharp-tailed and sage grouse and mourning doves are the game birds found throughout this reach. The steep and rugged canyon landscape of Reach #6 is an especially important area for cliff nesting raptors such as the golden eagle and prairie falcon. Canada geese and several species of ducks use the Missouri during their spring and fall migrations or throughout the ice-free months. This portion of the Missouri provides good Canada goose nesting habitat. Furbearers include beaver, raccoon, muskrat and mink.

## **INSTREAM FLOW METHODS:**

### Wetted Perimeter

Cross-sectional data were collected at three cross sections in one extensive riffle located near Cow Island. The WETP program was calibrated to field data collected at flows of 5,660, 8,200, 8,830, and 13,500 cfs. The upper inflection point of the wetted perimeter-flow relationship occurs at 4,700 cfs for the composite of three cross sections (Figure 3-7). Therefore, 4,700 cfs is the flow recommended to maintain riffle wetted perimeter.

### Maintenance of Side Channels

Side channels in Reach #6 are important habitat for forage fish production and rearing areas for sauger, goldeye, smallmouth buffalo and bigmouth buffalo. Water level conditions in a side channel are related to river flow. Gardner and Berg (1982) determined that a flow of 5,800 cfs is required for maintaining the side channels in a suitable condition. Rearing and forage fish use occurs from early June through August 31. Based on this information a flow of 5,800 cfs during the period June 1-August 31 is recommended to maintain suitable conditions in side channels for rearing and forage fish production.

### Canada Goose Nesting Requirements

A fair amount of Canada goose nesting occurs on the Missouri River in this reach. Constan and Hook (1981) reported that



an average of 13% of the total nests surveyed were in this reach. Adequate flows around the goose nesting islands are essential for protection against mammalian predators. A study of a goose nesting island in the Cow Island area indicated that a minimum flow of 7,100 cfs was required for nesting security (Hook, D., personal communication to Bill Gardner, DFWP 1989). Therefore, a flow of 7,100 cfs is recommended for the Canada goose nesting period, March 15-June 1.

#### Paddlefish Migration Requirement

Berg (1981) determined that paddlefish residing in Fort Peck Reservoir and the middle Missouri River require a flow of 15,302 cfs in Reach #6 to initiate their annual spring migration to upstream spawning sites. Maintenance of the paddlefish is dependent on a flow at or above 15,302 cfs during the 48-day period from May 19 through July 5. This time period was selected because it coincides with the biological requirements of paddlefish.

#### **WHY FLOW IS NECESSARY:**

The requested flows are necessary to maintain the existing resident game fish populations; to help meet the spawning flow requirement of paddlefish; to preserve the recreational values in the Wild and Scenic portion of the Missouri River; to maintain the security of island nesting sites for Canada geese; and to help protect the habitat of the wildlife species that depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

March 15-May 18; goose nesting	--	7,100 cfs ( 915,371 A.F.)
May 19-July 5; paddlefish	--	15,302 cfs (1,456,851 A.F.)
July 6-August 31; side channels	--	5,800 cfs ( 655,735 A.F.)
September 1-March 14; riffle maintenance	--	4,700 cfs (1,817,850 A.F.)
		<hr/> 4,845,807 A.F./yr.

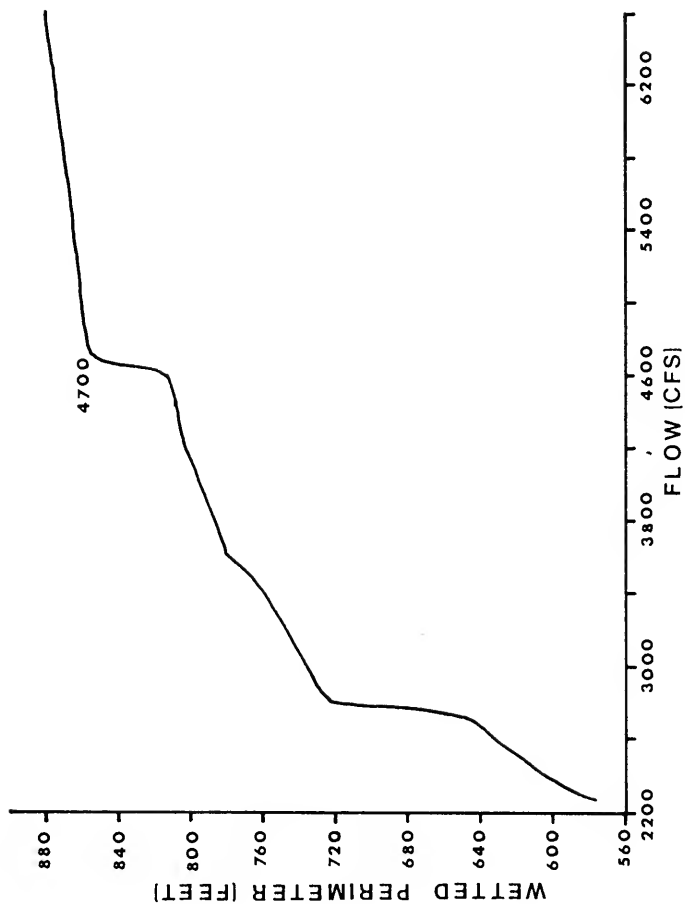


Figure 3-7. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Reach 6 of the Missouri River.

Missouri River Drainage Tributaries  
Between Canyon Ferry and Holter Dams

Figure 3-8 is a map representing the portion of the Missouri River Drainage between Canyon Ferry Dam and Holter Dam which shows the locations of the following streams discussed in this section.

Spokane Creek  
McGuire Creek  
Trout Creek  
Prickly Pear Creek  
Sevenmile Creek

Tenmile Creek  
Silver Creek  
Beaver Creek  
Willow Creek  
Cottonwood Creek

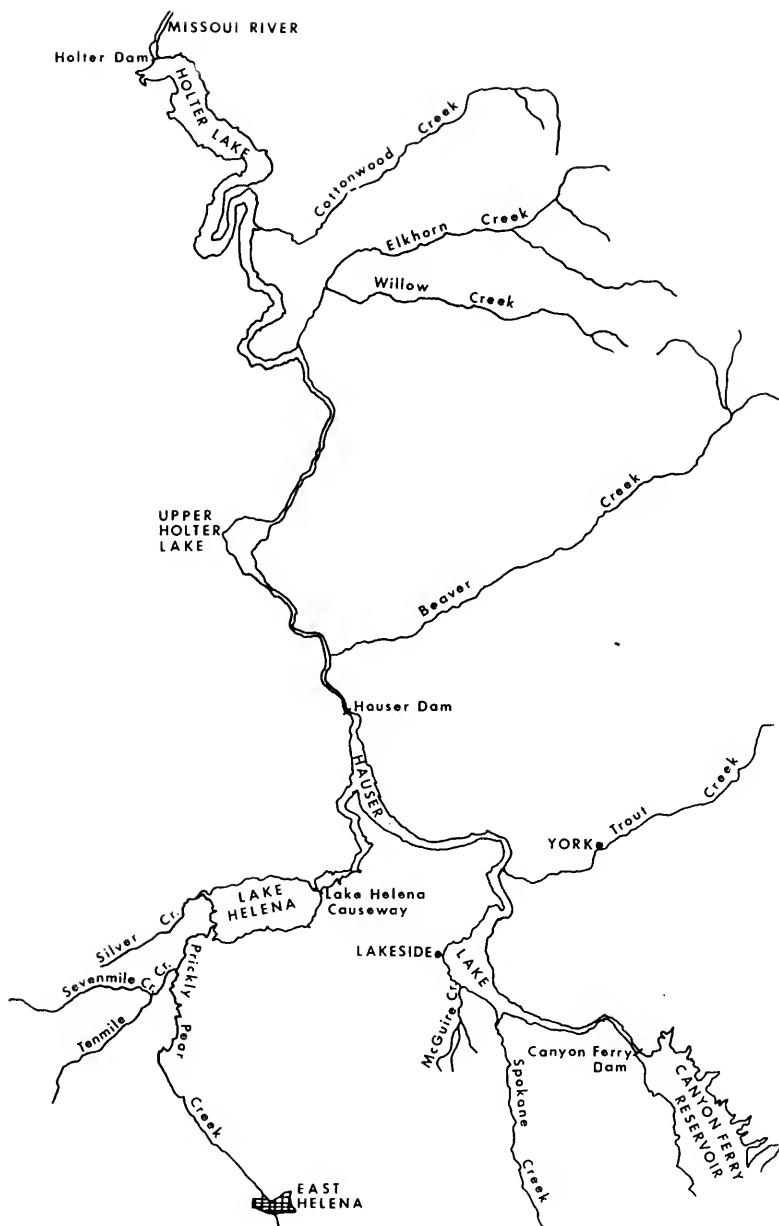


Figure 3-8. Map of the Missouri River Basin between Canyon Ferry Dam and Holter Dam.

**STREAM NAME:** Spokane Creek

**STREAM REACH:** From the Helena Valley Irrigation Canal to mouth--  
2.5 miles

**LOCATION:** Sec. 13A, T10N, R2W to Sec. 1B, T10N, R2W

**DESCRIPTION OF STREAM REACH:**

Spokane Creek originates in the Elkhorn Mountains southeast of Helena and flows northerly approximately 14.0 miles to its confluence with Hauser Reservoir. The elevation of the stream ranges from approximately 4,700 feet at the headwaters to 3,635 feet at the mouth. The mean gradient of the stream is about 1.4%. Spokane Creek drains mostly agricultural lands and ownership in the basin is almost 100% private. Grazing and farming are the major land uses in the drainage. Access is provided at several county road crossings and by permission of the private landowners.

Spokane Creek flows through mostly hilly, open country. The riparian zone is dominated primarily by cottonwood. From the headwaters to near the crossing of the Helena Valley Irrigation Canal, Spokane Creek tends to be intermittent as a result of both natural and irrigation losses of water. Downstream from the Helena Valley Irrigation Canal, Spokane Creek becomes a permanent stream due to gains from groundwater sources. This reach of stream displays spring creek-like characteristics with fairly stable flows and excellent aquatic vegetation development during the summer.

**GAME FISH PRESENT:** Brown trout, rainbow trout, mountain whitefish, kokanee

**FISHERY:**

Brown trout and rainbow trout comprise the resident sport fish in Spokane Creek. In addition, migrant brown trout, kokanee and mountain whitefish from Hauser Reservoir have been observed to use the stream for spawning. The magnitude of these resident and migratory populations has not been determined.

## WILDLIFE:

Big game species found along this reach of stream include white-tailed deer and mule deer. Hungarian partridge is the only known resident upland game bird. Furbearers include mink and muskrat. Good waterfowl habitat is present and use can be relatively heavy.

## WETTED PERIMETER:

The wetted perimeter methodology could not be used on Spokane Creek because discharge tends to be fairly stable throughout the year. Periodic discharge measurements made by the USGS and DFWP were used to determine base flow characteristics of this spring creek-like stream (Table 3-8). Discharge was measured near the Keil Lane Bridge (Sec. 1 and 12, T10N, R2W). Streamflow in Spokane Creek appears to be greatly influenced by the operation of the Helena Valley Irrigation Canal. Discharge increases in the creek during the irrigation season. In addition, accretions to flow from groundwater sources continue to add water downstream from the point at which flow measurements were made. Brown trout, kokanee and whitefish from Hauser Reservoir are able to utilize Spokane Creek in the fall for spawning because of the higher flow levels that occur during the irrigation season. To provide the higher flow levels necessary to maintain salmonid spawning, an average base summer flow is being requested for Spokane Creek for the period May through November. Once the irrigation season ends, the discharge in Spokane Creek gradually drops to base winter levels so an average base winter flow is being requested from December through April.

Table 3-8. Discharge measurements obtained on Spokane Creek during 1988.

Date Measured	Agency	Discharge (cfs)
2-26-88	DFWP	1.8
4-07-88	USGS	2.3
5-16-88	USGS	1.7
5-31-88	USGS	3.8
6-20-88	USGS	2.7
7-22-88	USGS	3.7
8-30-88	USGS	6.2
9-19-88	USGS	7.8

The USGS estimated the average base flow at 4 cfs between May and November and at 3 cfs between December and April (see Volume 1, Appendix A). These are the flows requested.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout fishery as well as to provide adequate spawning and rearing habitat for salmonids which migrate into the stream from Hauser Reservoir. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

May 1 - November 30	--	4.0 cfs	(1,698 A.F.)
December 1-April 30	--	3.0 cfs	( 898 A.F.)
			<hr/>
			2,596 A.F./yr.

**STREAM NAME:** McGuire Creek

**STREAM REACH:** Headwaters to mouth -- 2.8 miles

**LOCATION:** Sec. 10D, T10N, R2W to Sec. 35B, T11N, R2W

**DESCRIPTION OF STREAM REACH:**

McGuire Creek arises from springs located approximately 1 mile west of the Helena Valley Regulation Reservoir and flows northerly to its confluence with Hauser Reservoir. The elevation of the stream ranges from approximately 3,800 feet at the headwaters to 3,635 feet at the mouth. The mean gradient of the stream is about 1.1%. McGuire Creek drains agricultural lands and ownership in the basin is 100% private. Grazing and farming are the major land uses in the drainage. A former sapphire mine located near the mouth has historically altered the stream by removing gravel and adding sediment to the stream bed. Access is provided by a private road crossing near the mouth of the stream and by permission of the private landowners.

McGuire Creek flows through open hilly country for its entire length. The riparian zone is dominated by sedges and grasses. Sub-surface water sources provide fairly stable year-round flows and excellent aquatic vegetation is present throughout most of the year.

**GAME FISH PRESENT:** Brown trout, rainbow trout, kokanee

**FISHERY:**

A 500-foot section of McGuire Creek located in Sec. 35C, T11N, R2W was sampled by electrofishing during 1982 and 1986. Electrofishing survey data for salmonids are summarized in Table 3-9. The relatively large number of juvenile brown trout and rainbow trout collected in this reach indicated McGuire Creek provides important spawning habitat for salmonids residing in Hauser Reservoir. Both migrant brown trout and kokanee were collected in the stream during their fall spawning season. Spawning brown trout and kokanee up to 23.5 and 16.4 inches in length, respectively, were captured. Mottled sculpin were the only nongame species observed.



Table 3-9. Summary of electrofishing catch for 500 feet of McGuire Creek sampled during 1982 and 1986.

Date Sampled	Number Captured			Size Range (in.)		
	Rainbow Trout	Brown Trout	Kokanee	Rainbow Trout	Brown Trout	Kokanee
10/26/82	21	65	0	3.9-14.0	4.1-23.1	--
11/18/82	48	58	0	3.5-13.7	4.1-23.5	--
10/28/86	25	45	1	3.4-7.2	3.6-19.6	16.4

#### WILDLIFE:

Big game species found in the drainage include white-tailed deer and mule deer. Hungarian partridge is the only known resident upland game bird. Furbearers include mink and muskrat. Waterfowl habitat is limited.

#### WETTED PERIMETER:

The wetted perimeter methodology could not be used on McGuire Creek because discharge tends to be fairly stable throughout the year. Periodic discharge measurements made by the USGS and DFWP were used to determine base flow characteristics of this spring creek-like stream (Table 3-10). Discharge was measured immediately above the bridge located in Sec. 35, T11N, R2W. Flows in McGuire Creek appear to be greatly influenced by the operation of the Helena Valley Irrigation Canal. Discharge increases in McGuire Creek when the Helena Valley Irrigation Canal is in operation. Brown trout and kokanee from Hauser Reservoir are able to utilize McGuire Creek in the fall for spawning because of the higher flow levels that occur during the irrigation season. To provide the higher flow levels necessary to maintain salmonid spawning, an average base summer flow is being requested for McGuire Creek for the period May through November. Once the irrigation season ends, the discharge in McGuire Creek gradually drops to base winter levels so an average base winter flow is being requested from December through April.

Table 3-10. Discharge measurements obtained on McGuire Creek during 1982 and 1988.

Date Measured	Agency	Discharge (cfs)
12-2-82	DFWP	5.6
4-22-88	USGS	3.8
5-16-88	USGS	6.8
5-31-88	USGS	7.6
6-20-88	USGS	7.7
7-22-88	USGS	9.5
8-30-88	USGS	8.2
9-19-88	USGS	10.1

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the resident trout fishery as well as to provide adequate spawning and rearing habitat for salmonids which migrate into the stream from Hauser Reservoir. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### FLOW REQUEST:

May 1-November 30	-- 8.3 cfs	(3,523 A.F.)
December 1-April 30	-- 4.7 cfs	(1,408 A.F.)
		<u>4,931 A.F./yr.</u>

**STREAM NAME:** Trout Creek

**STREAM REACH:** From head of springs near Vigilante campground to mouth -- 9.0 miles

**LOCATION:** Sec. 30D, T12, R1E to Sec. 13C, T11N, R2E

**DESCRIPTION OF STREAM REACH:**

Trout Creek originates in the Big Belt Mountains approximately 30 miles northeast of the city of Helena and flows about 18 miles in a southwesterly direction to its confluence with Hauser Reservoir. The elevation of the stream ranges from approximately 6,000 feet at the headwaters to 3,635 feet at the mouth. The mean gradient of the stream is about 2.5%. Trout Creek flows through a narrow mountain canyon for its entire length. The narrow riparian zone is dominated by willow and water birch interspersed with conifers.

Trout Creek drains primarily national forest lands and recreation is the major land use in the basin. Land ownership in the drainage is approximately 95% public (Helena National Forest) and 5% private. A majority of the riparian corridor is privately owned and numerous houses have been built along the stream. Trout Creek has been substantially altered by both road construction and the development of home sites. Access is provided by county road #280 which parallels the stream from the mouth to Vigilante campground.

Flow in the upper 9.0 miles of the stream is intermittent and the channel is normally dry during the summer. The lower 9.0 miles of stream (discussed here) display spring creek-like characteristics, with sub-surface water sources providing fairly stable flows and water temperatures throughout most of the year. A major spring is located near Vigilante campground (Sec. 30D, T12N, R1E). Due to the size of the drainage basin, snowmelt and/or rain events can, at times, result in significant increases in flow.

**GAME FISH PRESENT:** Brown trout, rainbow trout, kokanee, mountain whitefish

## FISHERY:

Four sections of Trout Creek, totalling approximately 2,700 feet in length, were sampled by electrofishing in the fall of 1986. Three of the sections were located downstream from the town of York while the other section was located approximately 2 miles upstream from York. The two sections located nearest the mouth, totalling approximately 1,300 feet in length, also were sampled by electrofishing in the fall of 1987 and the spring of 1988. Legal descriptions of section locations are as follows: Sec. 13D, T11N, R2W; Sec. 18C, T11N, R1W; Sec. 18A, T11N, R1W; and Sec. 3D, T11N, R1W.

Electrofishing data are summarized in Table 3-11. Good populations of resident rainbow trout and brown trout were found in all four sections of stream. In addition, migrant rainbow trout, brown trout and kokanee of Hauser Reservoir origin were collected in Trout Creek during their respective spawning seasons. Rainbow and brown trout spawners up to 20.7 and 28.4 inches in length, respectively, were captured. A large number of migrant mountain whitefish also were observed during their fall spawning season. Trout Creek appears to be an important spawning and rearing tributary for salmonids residing in Hauser Reservoir. Migrant longnose suckers of reservoir origin and mottled sculpins were the nongame species observed.

Table 3-11. Summary of electrofishing survey data collected from four sections (2,700 feet) of Trout Creek during 1986 and two sections (1,300 feet) of Trout Creek during 1987 and 1988.

Date Sampled	Number Captured			Size Range (in.)		
	Rainbow Trout	Brown Trout	Kokanee	Rainbow Trout	Brown Trout	Kokanee
10/28/86	34	24	0	2.5-10.1	2.6-25.5	--
10/31/86	22	06	4	2.9-18.6	3.0-28.4	17.4-19.2
9/29/87	49	43	0	2.4-10.2	3.8-18.3	--
11/06/87	11	40	0	3.4-11.5	6.9-26.3	--
3/09/88	57	34	0	3.5-20.3	3.2-14.0	--
4/05/88	37	30	0	10.1-20.7	--	--

## WILDLIFE:

Big game species found along this reach include white-tailed deer, mule deer, elk, mountain lion and black bear. Mountain

goats are occasionally seen. Blue grouse, ruffed grouse and Merriam's turkey are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Waterfowl use is limited. Bald eagles and osprey are known to frequent the area.

#### **WETTED PERIMETER:**

The wetted perimeter methodology could not be used on Trout Creek because discharge tends to be fairly stable throughout the year. As a result, discharge measurements were made on Trout Creek during 1987 and 1988 to determine base flow characteristics of this spring creek-like stream (Table 3-12). Discharges were measured approximately 600 feet upstream from the mouth (Sec. 13C, T11N, R2W). A low flow measurement of 15.0 cfs obtained on March 30, 1988 is considered to be the base flow, and is requested to maintain the fishery.

Table 3-12. Discharge measurements obtained on Trout Creek during 1987 and 1988.

<u>Date Measured</u>	<u>Agency</u>	<u>Discharge (cfs)</u>
3-18-87	DFWP	18.4
3-25-87	DFWP	17.7
5-04-87	DFWP	18.6
5-18-87	DFWP	17.8
5-29-87	DFWP	19.3
8-24-87	DFWP	17.9
3-30-88	DFWP	15.0

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout fishery as well as to provide adequate spawning and rearing habitats for salmonids which migrate into the stream from Hauser Reservoir. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 15 cfs (10,860 A.F./yr.)

**STREAM NAME:** Prickly Pear Creek

**DESCRIPTION OF THE BASIN:**

Prickly Pear Creek originates at 6,800 feet in the Elkhorn Mountains within the Helena National Forest. It flows west out of the Elkhorns, then turns north and meanders through a narrow valley along the foothills of the Elkhorns for approximately 16.6 miles to East Helena. From East Helena it continues another 11.0 miles through a wide agricultural valley before discharging into Lake Helena, an impoundment that connects with Hauser Lake. Major tributaries include Beavertown, Clancy, Lump Gulch, Spring and McClellan creeks above East Helena and Ten Mile Creek below East Helena.

Streambed substrate consists primarily of cobble and gravel with considerable accumulation of silt near the lower end. Willow and alder constitute the primary riparian vegetation. Cottonwoods are common in some areas and ponderosa pine extend into the riparian zone in some areas in the upper drainage. In many areas above Montana City, the riparian zone has not recovered from damage done by gold dredging, road and railroad construction. In the lower valley, much of the riparian zone has been impacted by agricultural practices.

Human activities have had a major impact on Prickly Pear Creek. An interstate highway, an abandoned railroad, and a frontage road parallel the stream through the valley above East Helena and have altered much of the natural stream channel. Part of this section has also been seriously impacted by gold dredging.

In the past, water quality problems have periodically plagued Prickly Pear Creek. Causes have included sedimentation from gold dredging operations and highway construction, sewage pollution, thermal and metal pollution from the ASARCO plant in East Helena, and waste material entering the stream from the Kaiser Cement plant at Montana City. Presently, the point sources of the pollution problems above East Helena have been corrected. The Montana Department of Health and Environmental Sciences' water quality classification for the section of Prickly Pear Creek above East Helena includes the growth and propagation of salmonid fishes and associated aquatic life. The lower section is classified for agricultural and industrial use only. A large forest fire in the Elkhorns in 1988 may result in serious sedimentation problems in Prickly Pear Creek in the future.

Recreation is the major land use in the upper drainage. Between the Forest Service boundary and the town of East Helena, Prickly Pear Creek flows through three small communities and several rural housing developments. There has also been considerable housing development along some of the tributaries in recent years. Agriculture, including cattle grazing, hay and grain farming, is the main activity downstream from East Helena. Extensive irrigation from Prickly Pear Creek causes serious dewatering problems during most years, especially below East Helena.

**STREAM NAME:** Prickly Pear Creek

**STREAM REACH:** #1. From the confluence of Rabbit Gulch to the Highway 12 bridge in East Helena -- 23.2 miles

**LOCATION:** Sec. 19C, T7N, R2W to Sec. 25D, T10N, R3W

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

Rainbow trout are the most common trout found in the lower half of this reach, followed by brown trout. Brook trout found in the lower section are probably fish that drifted down from upstream or from tributaries.

Three sections of Prickly Pear Creek between Clancy and Montana City were electrofished twice in June of 1987. Fish collected in the three sections included 694 rainbow trout ranging from 3.5 inches to 13.8 inches, 206 brown trout ranging from 2.1 inches to 16.4 inches and 32 brook trout ranging from 5.2 inches to 10.2 inches in length.

Mark and recapture population estimates were conducted in each section. Data for the 3,300 foot "Old Altered" section are given in Tables 3-13 and 3-14.

Table 3-13. Rainbow trout population estimates for the "Old Altered" section of Prickly Pear Creek (3,300 feet), June 1987. (95% confidence limits in parentheses.)

<u>Length Group</u>	<u>Number Estimated</u>	<u>Condition Factor</u>
3.5 - 6.9	154 ( $\pm$ - 24)	38.61
7.0 - 9.9	91 ( $\pm$ - 18)	38.64
10.0 - 13.9	53 ( $\pm$ - 10)	35.44

Table 3-14. Brown trout population estimates for the "Old Altered" section of Prickly Pear Creek (3,300 feet), June 1987. (95% confidence limits in parentheses.)

<u>Length Group</u>	<u>Number Estimated</u>	<u>Condition Factor</u>
4.5 - 6.9	40 ( $\pm$ - 18)	35.91
7.0 - 15.9	39 ( $\pm$ - 10)	36.40



The populations of the other two sections sampled were very similar in species, numbers and sizes present. The section of Prickly Pear Creek located between the mouth of Spring Creek (at Jefferson City) and Clancy (approximately 7.0 miles) is impacted by heavy metals pollution from past mining activities in the upper Spring Creek area. This section appears to have a trout population that is present during periods of acceptable water quality and moves elsewhere during periods of unacceptable water quality (Knudson 1981). This situation may be rectified by an active mining operation in the area that is totally dewatering the Spring Creek drainage and reducing the source of metals to Prickly Pear Creek.

Above the confluence of Spring Creek, the Prickly Pear Creek fishery is dominated by a large population of brook trout that range between 4 and 11 inches in length.

Major problems affecting the fishery within this reach include heavy metals pollution, instream sediment resulting from highly erodible soils and past placer mining activities, and development activities, including subdivisions, in the riparian zone.

#### **WILDLIFE:**

The narrow band of riparian vegetation along Prickly Pear Creek supports resident white-tailed deer and wintering mule deer. The upper drainage supports resident elk, moose and black bear. Blue and ruffed grouse inhabit the upper drainage and a few Hungarian partridge are found in the lower end of this reach. Furbearers include beaver, muskrat, mink, bobcat, red fox and coyote. Mallards and mergansers nest along this reach of stream and some waterfowl use the area during spring and fall migrations.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on Prickly Pear Creek approximately 2 miles upstream from Montana City (Sec. 23C, T9N, R3W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 36.2, 52.4 and 105.1 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-9. Lower and upper inflection points occur at approximate flows of 8 and 22 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population; to maintain spawning habitat and provide flows for rainbow and brown trout that migrate into this reach from the Lake Helena-Hauser Reservoir complex to spawn; and to protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 22 cfs (15,927 A.F./yr.)

# PRICKLY PEAR CREEK (reach 1)

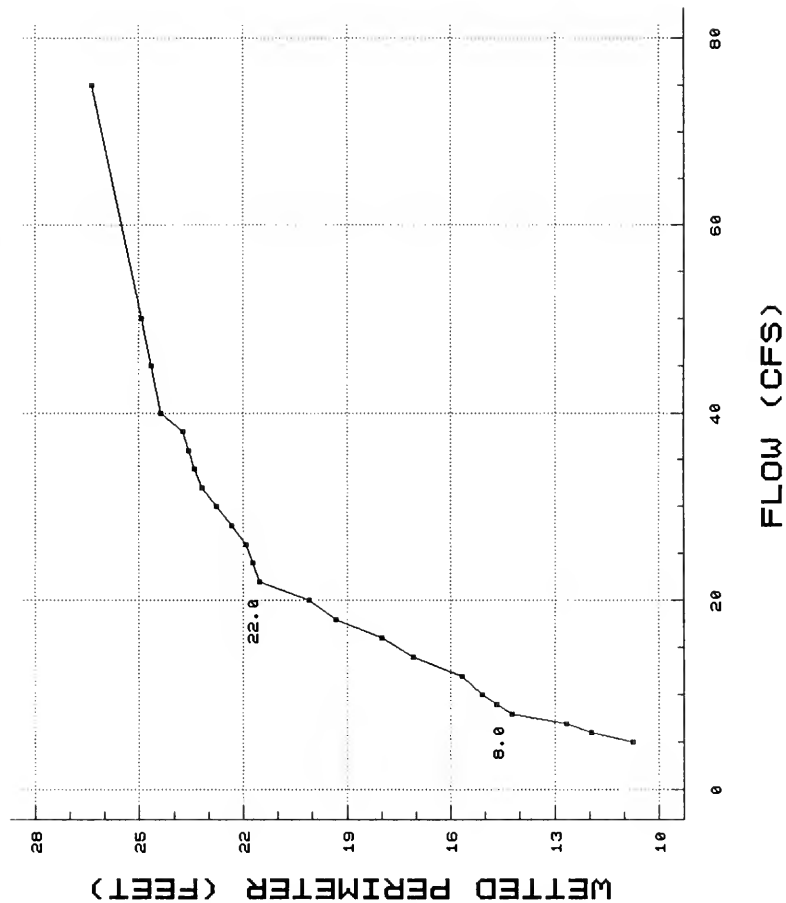


Figure 3-9. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 1 of Prickly Pear Creek.

**STREAM NAME:** Prickly Pear Creek

**STREAM REACH:** #2. From the Highway 12 bridge in East Helena to Lake Helena -- 11.0 miles

**LOCATION:** Sec. 25D, T10N, R3W to Sec. 26B, T11N, R3W

**GAME FISH PRESENT:** Brown trout, rainbow trout, brook trout, cutthroat trout

**FISHERY:**

Brown trout are the most common trout found in this reach, followed by rainbow trout. Brook and cutthroat trout found in this reach are probably fish that drifted down from upstream.

Several sections of Prickly Pear Creek just upstream from the confluence with Tenmile Creek were electrofished twice in the fall of 1981 and 6 times during the spring, summer and fall in 1982 (Berg and Lere 1983). Trout collected included 357 adult brown trout ranging from 9.3 to 23.5 inches, 197 brown trout less than 9.25 inches, 40 rainbow trout ranging from 4.4 to 18.5 inches, 1 cutthroat and 1 brook trout. Nongame fish include white and longnose suckers, longnose dace and mottled sculpin. Many of the trout collected after the first electrofishing run were recaptures from previous sampling, indicating that most of them were resident fish. No attempt was made to do a population estimate in this reach.

In addition to the resident fishery, some brown trout and rainbow trout migrate up Prickly Pear Creek from the Lake Helena-Hauser Reservoir complex to spawn. The extent of these migrations has not been quantified.

Major problems affecting the fishery in this reach include serious dewatering that occurs annually, and the accumulation of large amounts of instream sediment as a result of agricultural practices and irrigation return flows.

**WILDLIFE:**

Big game species found along this reach include white-tailed deer and a few antelope. Hungarian partridge is the primary game bird. Furbearers include beaver, muskrat, mink, red fox and coyote.

Waterfowl, including mallards, teal, common mergansers and an occasional Canada goose, use this reach for nesting and rearing in the spring and early summer. Migratory waterfowl also use the stream in the fall.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in an approximate 800-foot section of Prickly Pear Creek just upstream from the confluence of Tenmile Creek (Sec. 34C, T11N, R3W). Three riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 23.6, 27.9, 32.3 and 50.0 cfs.

The relationship between wetted perimeter and flow for a composite of the three riffle cross sections is shown in Figure 3-10. Lower and upper inflection points occur at approximate flows of 14 and 30 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout fishery; to support trout spawning migrations in the spring and fall; and to protect the habitat for wildlife species which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 30 cfs (21,719 A.F./yr.)

# PRICKLY PEAR CREEK (reach 2)

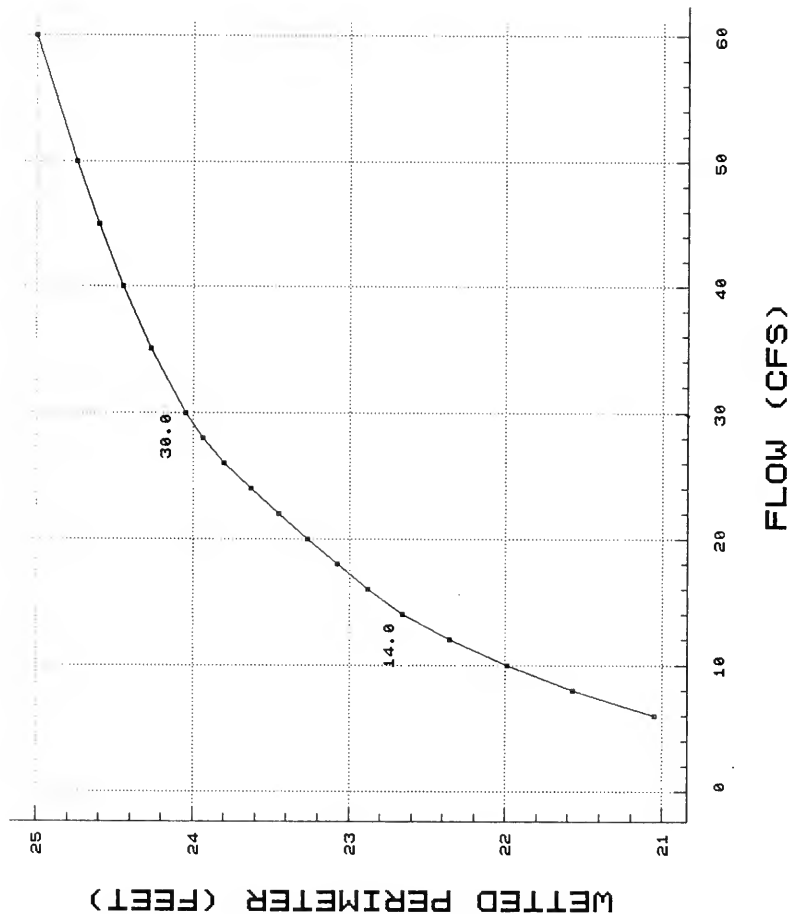


Figure 3-10. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Reach 2 of Prickly Pear Creek.

**STREAM NAME:** Sevenmile Creek

**STREAM REACH:** From the confluence of Greenhorn Creek and Skelly Gulch to the mouth--7.6 miles

**LOCATION:** Sec. 2A, T10N, R5W to Sec. 13B, T10N, R4W

**DESCRIPTION OF STREAM REACH:**

Sevenmile Creek originates at the confluence of Greenhorn Creek and Skelly Gulch approximately 6.0 miles west of the city of Helena and flows easterly to its confluence with Tenmile Creek. The elevation of the stream ranges from approximately 4,500 feet at its point of origin to 4,100 feet at the mouth. The mean gradient of the stream is about 1.0%. Sevenmile Creek flows through an open agricultural valley for its entire length. The riparian zone has been substantially altered by agricultural practices with willow being the dominant riparian vegetation. Beaver dams are common.

Sevenmile Creek drains mostly hilly, open country. Major land uses in the basin include grazing, hayland and small grain farming. Land ownership in the drainage is about 75% private and 25% public (Bureau of Land Management and military reservation).

Approximately 65% of the stream corridor is under private ownership with the remainder located in the military reservation. Railroad construction has altered the upper 4.5 miles of Sevenmile Creek. Access, controlled by private land owners, is provided by a county road and Highway 356 which follow the creek from its point of origin to approximately 4.5 miles downstream. In addition, the Head Lane Bridge provides an access point within military reservation lands.

**GAME FISH PRESENT:** Rainbow trout, brook trout

**FISHERY:**

Two sections of Sevenmile Creek were electrofished in the fall of 1987 and the spring of 1988. The first section, located downstream from Head Lane (Sec. 11C, T10N, R4W) consisted of a narrow, deeply entrenched channel with a gravel and silt bottom and limited fish habitat. This section was located below a major irrigation diversion. The second section was located approximately 1/2 mile above Birdseye Road crossing

(Sec. 5A, T10N, R4W) and was upstream of the irrigation diversion. Fish habitat in this section was excellent and consisted of a series of beaver ponds with good overhanging and submerged vegetation. Substrate in this section was silt.

Rainbow and brook trout were collected from both sample areas (Table 3-15). Mottled sculpin were also observed at both sites. Only 1 rainbow trout and 1 brook trout greater than 6.0 inches long were collected from the lower sample area. This area appeared to provide rearing habitat for small fish but lacked holding areas for larger fish. The upper sample area contained a good size distribution of trout. In addition, several young-of-year rainbow trout were collected in the upper sample area indicating that natural reproduction was occurring.

Table 3-15. Summary of electrofishing catch for two sections of Sevenmile Creek sampled in 1987 (500 feet) and 1988 (300 feet).

Date	Species	Number Captured	Mean Length (in.)	Length Range (in.)
10/13/87	Rainbow trout	29	3.7	2.8-11.6
10/13/87	Brook trout	27	4.2	3.2-8.2
6/07/88	Rainbow trout	51	6.4	1.1-8.7
6/07/88	Brook trout	39	6.6	4.8-10.5

#### WILDLIFE:

Big game species found in the drainage include white-tailed deer, mule deer, antelope, elk, black bear and mountain lion. Blue grouse, ruffed grouse and Hungarian partridge are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Waterfowl use is limited.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 300-foot section of Sevenmile Creek located approximately 0.1 miles upstream from the Head Lane Bridge (Sec. 10D, T10N, R4W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 1.5, 2.6 and 4.5 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-11. An upper inflection point occurs at an approximate flow of 1.0 cfs.



**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations and to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

**FLOW REQUEST:**

January 1- December 31 -- 1.0 cfs (724 A.F./yr.)

## SEVENMILE CREEK

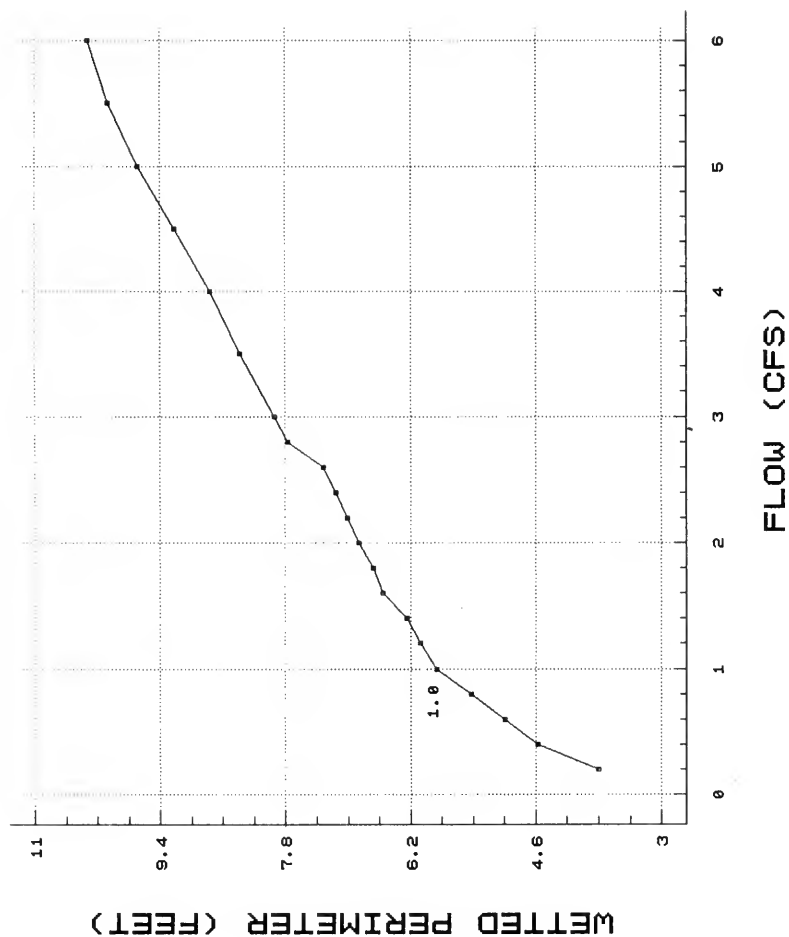


Figure 3-11. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Sevenmile Creek.

**STREAM NAME:** Tenmile Creek

**STREAM REACH:** From headwaters to mouth -- 27.5 miles

**LOCATION:** Sec. 23D, T8N, R6W to Sec. 34B, T11N, R3W

**DESCRIPTION OF STREAM REACH:**

Tenmile Creek originates near the Continental Divide southwest of the city of Helena and flows northeasterly to its confluence with Prickly Pear Creek. The elevation of the stream ranges from approximately 6,750 feet at the headwaters to 3,680 feet at the mouth. The mean gradient of the stream is about 2.1%. From the headwaters to the confluence with Sweeney Creek, the stream flows through a narrow mountain canyon. Downstream from this point, the creek parallels U.S. Highway 12 through a broader mountain valley to Helena. From Helena, the stream meanders out into the agricultural lands of the Helena valley to its confluence with Prickly Pear Creek. Major tributaries include Ruby, Beaver, Sweeney and Sevenmile creeks. Gould Reservoir, a small impoundment used for mining and located at the head of Beaver Creek, is used to augment flow in Tenmile Creek to provide municipal water to the city of Helena. A USGS gauging station, located at mile 20.4 in Sec. 20, T9N, R5W, has been in operation since 1914. The average annual discharge at this station for a 70-year period of record is 18 cfs (13,040 acre-feet). Another gage was operated at stream mile 8.1 from 1908-1954. The average annual discharge for the 46-year period of record was 27.2 cfs (19,692 acre-feet).

For the segment of creek located upstream from Helena, the riparian zone is relatively narrow and is dominated by cottonwoods interspersed with conifers. Downstream from Helena the riparian zone broadens but has been substantially altered by agricultural practices. The dominant riparian vegetation in this segment of stream are cottonwoods and willows. The upper 14 miles of stream primarily drain forest lands while the lower 13.5 miles of stream primarily drain agricultural lands.

Approximately 80% of the stream corridor is in private ownership. Access is provided by several county road crossings in the Helena valley, U.S. Highway 12, which parallels the stream for about 7 miles, and a gravel road that parallels the stream from near Sweeney Creek upstream into the headwaters.

From the headwaters downstream to Helena, Tenmile Creek has been substantially altered due to road construction and mining. Water quality in the upper drainage has been adversely impacted by mining. Downstream from Helena, irrigation withdrawals can be excessive, resulting in total dewatering in some reaches of the stream. Both the small community of Rimini and the city of Helena use Tenmile Creek for a municipal water supply.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

A 550-foot section of Tenmile Creek located just downstream from the settling basin for municipal water near the Rimini turnoff was sampled on June 15, 1988 (Sec. 34D, T10N, R5W). This section flowed through a narrow canyon with a well developed riparian area. Substrate was predominantly boulders and bedrock. Several good bedrock pools were present in the section. Rainbow trout and brook trout were the only game fish collected in the reach, with rainbow trout comprising 81% of the total catch (Table 3-16). Although not included in the summary table, numerous young-of-the-year rainbow trout also were observed. Six of these juvenile fish were collected and ranged from 1.3 to 2.0 inches in length. Mottled sculpin were the only other fish species observed. Although brown trout were not collected in the section, this species is known to reside in the lower reaches of Tenmile Creek (Berg and Lere 1983).

Table 3-16. Summary of electrofishing catch for 550 feet of Tenmile Creek sampled June 10, 1988.

Species	Number Captured	Length Range (in.)
Rainbow trout	48	3.4-10.6
Brook trout	11	4.6-10.9

Results of a two-pass method (Leathe 1983) population estimate for this section of stream are shown in Table 3-17.

Table 3-17. Estimated trout population in 550 feet of Tenmile Creek sampled June 10, 1988. (80% confidence intervals are in parentheses.)

Species	Length group (in.)	Number per 550 ft.
Rainbow trout	3.4-10.6	68 ( $\pm$ 6)
Brook trout	4.6-10.9	13 ( $\pm$ 1)
Combined trout	3.4-10.9	81 ( $\pm$ 6)
Combined trout	> 6.0	27 ( $\pm$ 5)

#### WILDLIFE:

Big game species found in the drainage include mule deer, white-tailed deer, elk, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Good waterfowl habitat is found in the segment of creek located downstream from Helena.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 260-foot section of Tenmile Creek located approximately 900 feet downstream from the Sierra Road Bridge (Sec. 33D, T11N, R3W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 4.7, 14.5 and 34.5 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-12. Lower and upper inflection points occur at approximate flows of 4.0 and 12.0 cfs, respectively.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population and to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### FLOW REQUEST:

January 1-December 31 -- 12.0 cfs (8,688 A.F./yr.)

# TENMILE CREEK

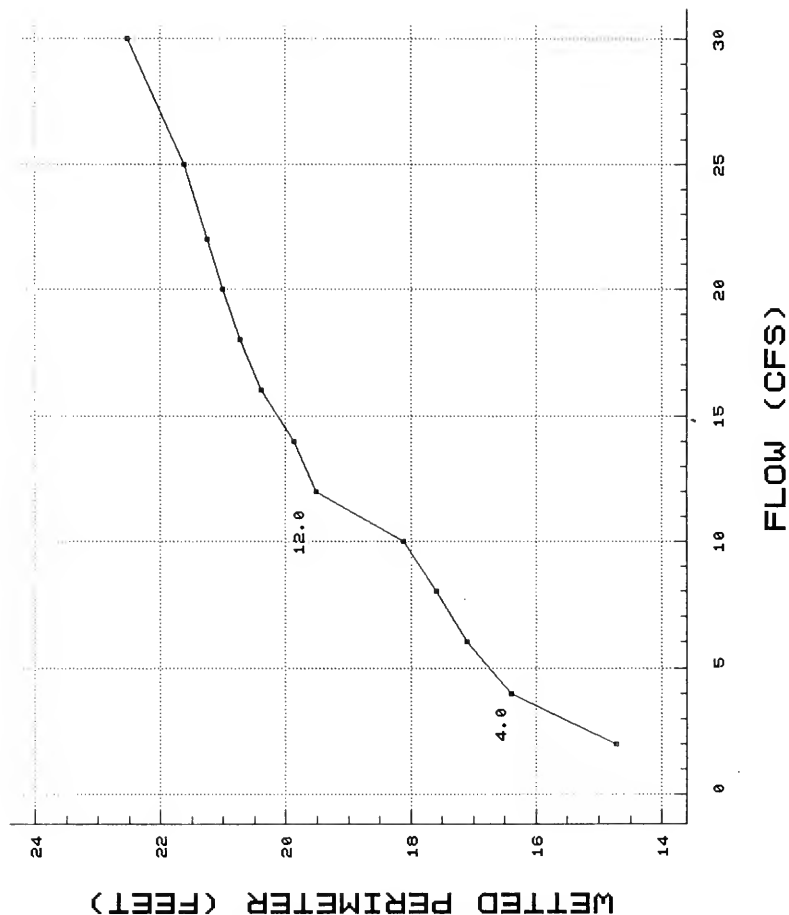


Figure 3-12. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Tenmile Creek.

**STREAM NAME:** Silver Creek

**STREAM REACH:** From the Helena Valley Irrigation Canal to mouth -  
- 5.3 miles

**LOCATION:** Sec. 25A, T11N, R4W to Sec. 22A, T11N, R3W

**DESCRIPTION OF STREAM REACH:**

Silver Creek originates near the town of Marysville and flows approximately 20 miles in an easterly direction to its confluence with Lake Helena. The elevation of the stream ranges from approximately 5,200 feet at the headwaters to 3,636 feet at the mouth. The mean gradient of the stream is about 1.5%. Silver Creek drains primarily agricultural lands and ownership in the basin is approximately 90% private and 10% public (BLM). Grazing, farming and mining are the major land uses in the basin. A small ski area is located in the headwaters. Access is provided by several county roads and highways that cross Silver Creek, with 1 county road closely paralleling the stream for about 6 miles into the headwaters.

From the headwaters to the crossing of the Helena Valley Irrigation Canal, Silver Creek flows through mostly hilly, open country. Water losses due to irrigation, however, result in a totally dewatered channel before the stream passes the Scratchgravel Hills and enters the Helena valley. The riparian zone within this upper reach of stream is dominated by willows. Water quality in the upper drainage of Silver Creek has been adversely impacted by mining activity. Fish in this reach of stream commonly exceed health recommendations for mercury levels.

Downstream from the Helena Valley Irrigation Canal, Silver Creek has been channelized into a ditch that drains agricultural lands of the valley. Drainage tiles that have been placed in surrounding fields direct sub-surface water into this canal providing fairly stable flows and water temperatures throughout most of the year. This canal displays spring-like characteristics with excellent aquatic vegetation development during the summer. Several irrigation ditches also return water to the canal. As a result, irrigation practices can influence flow patterns during the summer.

**GAME FISH PRESENT:** Brown trout, rainbow trout, brook trout, kokanee

## FISHERY:

A 1,500-foot section of Silver Creek located immediately downstream from the Interstate Highway 15 bridge (Sec. 29D, T11N, R3W) was sampled by electrofishing during 1986, 1987 and 1988. Electrofishing data are summarized in Table 3-18. The large number of juvenile rainbow trout and brown trout collected in this reach of stream indicates Silver Creek provides important rearing habitat for these two species. Silver Creek also provides important spawning habitat for salmonids residing in Hauser Reservoir and Lake Helena. Migrant rainbow trout, brown trout and kokanee of reservoir origin were collected in Silver Creek during their respective spawning seasons. Rainbow trout, brown trout and kokanee spawners up to 16.7, 25.4 and 20.0 inches in length, respectively, were captured. Mottled sculpins were the only nongame species observed.

Table 3-18. Summary of electrofishing catch for a 1,500-foot section of Silver Creek sampled during 1986, 1987 and 1988.

Date Sampled	Number Captured			Size Range (in.)		
	Rainbow Trout	Brown Trout	Brook Trout	Rainbow Trout	Brown Trout	Brook Trout
10/29/86	178	363	8	3.2-12.2	3.5-23.2	4.2-12.3
11/04/87	62	345	0	3.6-18.0	4.0-25.4	--
3/11/88	26	99	0	3.7-10.5	3.9-16.7	--
4/05/88	5	7	1	6.2-16.7	4.9-13.1	9.0

## WILDLIFE:

Big game species found along this reach include white-tailed deer and mule deer. Hungarian partridge is the only known resident upland game bird. Furbearers include mink and muskrat. Good waterfowl habitat is present and waterfowl use can be heavy.

## WETTED PERIMETER:

The wetted perimeter methodology could not be used on this reach of Silver Creek because discharge did not vary enough to enable calibration of the WETP model. Periodic discharge measurements made by the USGS and DFWP were used to determine base flow characteristics of this spring creek-like stream (Table 3-19). Discharges were measured just downstream from the east frontage



road bridge (Sec. 29D, T11N, R3W). Discharge in Silver Creek appears to be greatly influenced by irrigation practices. Discharge in the creek tends to increase during the irrigation season. Brown trout and kokanee from Hauser Reservoir and Lake Helena are able to utilize Silver Creek in the fall for spawning because of the higher flow levels that occur during the irrigation season. To provide the high flow levels necessary to maintain salmonid spawning, an average base summer flow is being requested for Silver Creek for the period May through November. Once the irrigation season ends, the discharge in Silver Creek gradually drops to base winter levels, so an average base winter flow is being requested from December through April.

Table 3-19. Discharge measurements obtained on Silver Creek during 1982 and 1988.

Date Measured	Agency	Discharge (cfs)
12-2-82	DFWP	7.6
2-26-88	DFWP	3.3
4-07-88	USGS	2.9
5-16-88	USGS	10.0
5-31-88	USGS	11.4
6-20-88	USGS	18.1
7-22-88	USGS	14.3
8-30-88	USGS	13.0
9-19-88	USGS	11.2

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the resident trout fishery as well as to provide adequate spawning and rearing habitats for salmonids which migrate into the stream from Hauser Reservoir and Lake Helena. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### FLOW REQUEST:

May 1 -November 30 -- 13.0 cfs (5,518 A.F.)

December 1-April 30 -- 5.4 cfs (1,617 A.F.)

7,135 A.F./yr.

**STREAM NAME:** Beaver Creek

**STREAM REACH:** From headwaters to mouth -- 17.1 miles

**LOCATION:** Sec. 8A, T13N, R1W to Sec. 19A, T12N, R2W

**DESCRIPTION OF STREAM REACH:**

Beaver Creek originates in the Big Belt Mountains and flows southwesterly to its confluence with the Missouri River. The elevation of the stream ranges from approximately 5,100 feet at the headwaters to 3,590 feet at the mouth. The mean gradient of the stream is about 1.7%. From the headwaters to the town of Nelson, the stream flows through a narrow limestone canyon. Downstream from Nelson, the stream meanders through a meadowed floodplain. The riparian zone is dominated by willows and cottonwoods. Extensive beaver dams and associated ponds are located throughout the stream.

A U.S. Forest Service gauging station is located in Sec. 16C, T12N, R2W. This gauge has been in operation during the ice-free period since 1979. With the exception of the extreme headwaters, Beaver Creek drains national forest lands including a portion of the Gates of the Mountains Wilderness. Recreation is the major land use in the basin. Approximately 5.5 miles of stream in the headwaters and 2.5 miles of stream located just upstream from Nelson are in private ownership. Access is provided by an unimproved road which parallels the stream from the mouth to a point 12 miles upstream.

Beaver Creek has been substantially altered due to road and pipeline construction. In addition, the lower 2 miles of stream historically were dewatered for irrigation prior to U.S. Forest Service acquisition in 1974. Much of the drainage was burned in a 1984 forest fire. A flood event that occurred immediately following the fire deposited large amounts of fine sediment into the stream. Much of this sediment remains trapped behind beaver dams and erosion control devices constructed by the U.S. Forest Service.

**GAME FISH PRESENT:** Rainbow trout, brook trout, brown trout, cutthroat trout, rainbow x cutthroat trout hybrids

## FISHERY:

Resident trout populations provide a good fishery in Beaver Creek. Fall population estimates of resident game fish made in a 1,000-foot section located 1 mile downstream from Nelson are given in Table 3-20. Although resident trout were nearly eliminated from the stream following the 1984 fire and flood, populations have recovered rapidly to near pre-fire levels. The only forage species known to reside in the stream is the mottled sculpin.

Table 3-20. Rainbow trout and brown trout population estimates obtained in 1,000 feet of Beaver Creek during the fall of 1982, 1983, 1984 and 1985. (80% confidence intervals in parentheses.)

Year	Estimated number per 1,000 ft.	
	Rainbow Trout	Brown Trout
<sup>a</sup> 1982	879 ( $\pm$ 310)	51 ( $\pm$ 5)
<sup>a</sup> 1983	500 ( $\pm$ 186)	28 ( $\pm$ 7)
<sup>b</sup> 1984	No catch	No catch
<sup>b</sup> 1985	840 ( $\pm$ 78)	Only 4 sampled-- no estimate

<sup>a</sup> From White, R.G. et. al. (1984). (Sec. 2 data)

<sup>b</sup> From Novak, M.A. and R.G. White (1986). (Sec. 2 data)

Rainbow trout from the Missouri River and Holter Reservoir spawn extensively in Beaver Creek from late March through early June. Adfluvial rainbow trout provide an excellent fishery in the stream during late May and early June. The number of migrant rainbow trout collected by electrofishing in 1982 and 1983 are shown in Table 3-21. Brown trout of river or reservoir origin occasionally use the stream for spawning. However, the use of the stream by brown trout migrants depends upon the extent of beaver dam construction and appropriate flow levels during the fall.

Table 3-21. Number and mean length of adfluvial rainbow trout collected in Beaver Creek during 1982 and 1983.

Year <sup>1</sup>	Number Sampled	Length (in.)	
		Mean	Range
1982	245	16.1	9.8-23.3
1983	631	16.4	9.8-20.7

<sup>1</sup> From White, R.G. et. al. (1984).

#### **WILDLIFE:**

Big game species found in the drainage include white-tailed deer, mule deer, moose, elk, mountain goat, bighorn sheep, black bear and mountain lion. Blue grouse, ruffed grouse and Merriam's turkey are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Waterfowl use is very limited. Bald eagles, ospreys and other raptors are known to frequent the stream corridor.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 400-foot section of Beaver Creek located approximately 1,500 feet above the mouth (Sec. 19, T12N, R2W). Four riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 5.7, 10.7 and 21.9 cfs.

The relationship between wetted perimeter and flow for a composite of the 4 riffle cross sections is shown in Figure 3-13. Lower and upper inflection points occur at approximate flows of 4.0 and 10.0 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population as well as to provide adequate spawning and rearing habitats for adfluvial trout from the Missouri River and Holter Reservoir. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 10.0 cfs (7,240 A.F./yr.)

# BEAVER CREEK

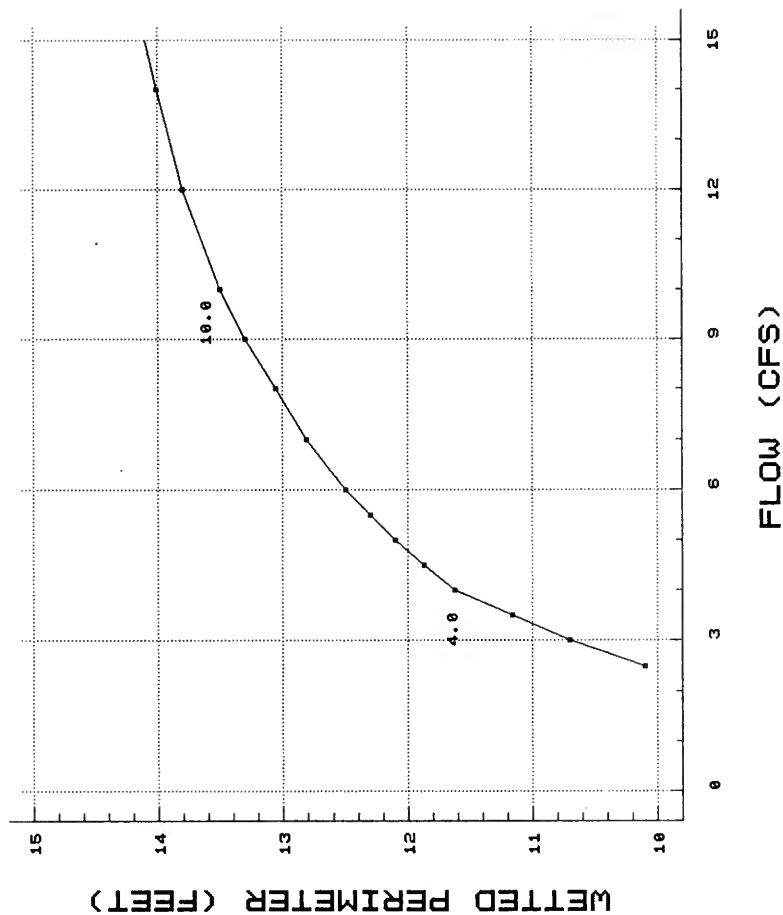


Figure 3-13. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Beaver Creek.

**STREAM NAME:** Willow Creek

**STREAM REACH:** From headwaters to mouth -- 9.8 miles

**LOCATION:** Sec. 9C, T13N, R1W to Sec. 12D, T13N, R3W

**DESCRIPTION OF STREAM REACH:**

Willow Creek originates on the northern edge of the Gates of the Mountains Wilderness and flows westerly to its confluence with Holter Reservoir. The elevation of the stream ranges from approximately 5,500 feet at the headwaters to 3,578 feet at the mouth. The mean gradient of the stream is about 3.7%. Elkhorn Creek is a major tributary to the stream. From the headwaters to its confluence with Elkhorn Creek, the stream flows through a narrow mountain canyon. Downstream from this point, the creek passes through a broader mountain valley. The riparian zone is dominated by willows and cottonwoods. Extensive beaver dams are located throughout the stream. A gabion drop structure constructed on Elkhorn Creek in the early 1970s serves as a barrier which isolates a population of genetically pure westslope cutthroat trout in the upper drainage. This drop structure is located about 2.0 miles upstream from the confluence with Willow Creek and serves to insure genetic integrity of these native fish.

Willow Creek drains forest lands of the Gates of the Mountains Wilderness and lands of DFWP's Beartooth Game Management Area. Ownership of the basin is 100% public (Helena National Forest and Montana Department of Fish, Wildlife and Parks). Land uses in the drainage include recreation and winter range for various big game species. Prior to acquisition by DFWP, the lower 2.0 miles of Willow Creek were used to irrigate hayland. Access is provided by an unimproved road that parallels the stream from near the mouth to approximately 4.5 miles upstream. In addition, an unimproved road parallels Elkhorn Creek from its confluence with Willow Creek to a point 5.0 miles upstream.

**GAME FISH PRESENT:** Brook trout, rainbow trout, rainbow x cutthroat trout hybrids, cutthroat trout

## FISHERY:

A 500-foot section of Willow Creek located along an old hay meadow approximately 3/4 mile downstream from the confluence with Elkhorn Creek (Sec. 6C, T13N, R2W) was sampled by electrofishing on September 2, 1987. The shocking section included two small beaver ponds connected by a run-pool sequence and one shallow riffle section. Depth, overhanging vegetation and undercut banks provided good fish habitat. Substrate was comprised of gravel in the riffle area and heavy silt in the pools.

Brook trout made up over 90% of the total catch, with rainbow trout making up the rest (Table 3-21). A large number of mottled sculpins were also observed. A two-pass method (Leathe 1983) population estimate determined there were 68 ( $\pm 1$ , 80% confidence) trout of all sizes and 20 trout greater than 6.0 inches in this 500-foot section of stream.

The use of the stream by migratory spawners from Holter Reservoir undoubtedly varies seasonally and from year to year depending upon the extent of beaver dam construction. The manager of the Beartooth Game Range has observed adfluvial rainbow trout and brown trout utilizing Willow and Elkhorn creeks for spawning in past years.

Table 3-21. Summary of electrofishing catch for 500 feet of Willow Creek sampled September 2, 1987.

Species	Number Captured	Length Range (in.)
Rainbow trout	57	2.6-8.8
Brook trout	6	2.6-9.4

## WILDLIFE:

Big game species found in the drainage include white-tailed deer, mule deer, elk, moose, bighorn sheep, mountain goat, antelope, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. The lower 2 miles of the stream provide fair waterfowl habitat. Bald eagles, ospreys and other raptors are known to frequent the stream corridor. Peregrine falcons have been released within 2.5 miles of the mouth of Willow Creek in attempt to establish a breeding population.

**WETTED PERIMETER:**

Cross-sectional data were collected in a 500-foot section of Willow Creek located approximately 0.75 miles downstream from the confluence with Elkhorn Creek (Sec. 6C, T13N, R2W). Three riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 1.4, 5.1, and 13.0 cfs.

The relationship between wetted perimeter and flow for a composite of the 3 riffle cross sections is shown in Figure 3-14. An upper inflection point occurs at an approximate flow of 3.5 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population as well as to provide adequate spawning and rearing habitats for adfluvial trout from Holter Reservoir. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 3.5 cfs (2,534 A.F./yr.)



# WILLOW CREEK

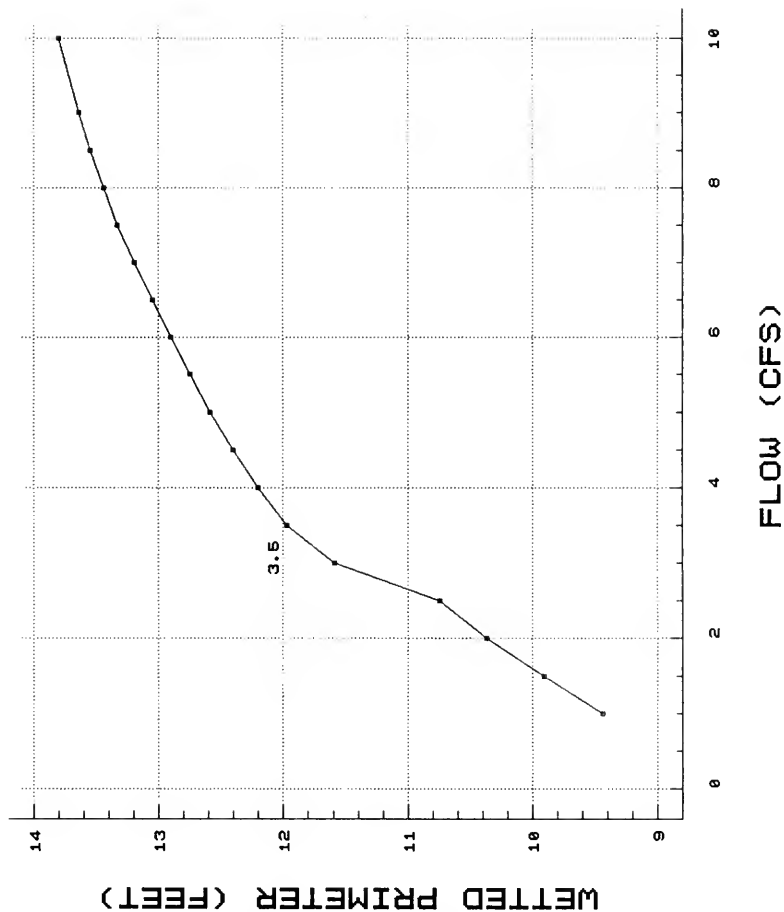


Figure 3-14. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Willow Creek.

**STREAM NAME:** Cottonwood Creek

**STREAM REACH:** From headwaters to mouth -- 8.2 miles

**LOCATION:** Sec. 12B, T14N, R2W to Sec. 35A, T14N, R3W

**DESCRIPTION OF STREAM REACH:**

Cottonwood Creek originates on the northern edge of the Beartooth Wildlife Management Area and flows southwesterly through a narrow mountain canyon to its confluence with Holter Reservoir. The elevation of the stream ranges from approximately 4,816 feet at the headwaters to 3,578 feet at the mouth. The mean gradient of the stream is about 2.9%. The narrow riparian zone is dominated by cottonwoods and dense willows. Numerous beaver dams and associated ponds are found within the lower 2 miles of the stream.

Cottonwood Creek drains lands that are used for recreation and as winter range for various big game species. Historically, these lands were used for cattle and sheep grazing. With the exception of the extreme headwaters, the entire drainage basin is in public ownership under the Montana Department of Fish, Wildlife and Parks. Access is provided by an unimproved road that parallels the upper 7.5 miles of the stream. This road crosses the stream in several locations.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout

**FISHERY:**

A resident population of brook trout provides for a limited fishery in Cottonwood Creek. Intermittent flows during low water years limit the numbers of these resident fish. Ponding by beaver dams, however, apparently provides adequate sanctuary during low water years to maintain a viable resident population.

Rainbow trout from Holter Reservoir occasionally utilize the stream for spawning during April and May. The use of the stream by migratory spawners undoubtedly varies seasonally and from year to year depending upon the extent of beaver dam construction. A total of 46 rainbow spawners were collected by electrofishing in May 1982. These spawners ranged from 9.8-22.1 inches in total length and 0.4-3.90 pounds in weight. Brown trout of reservoir origin rarely use the stream for

spawning due to low fall flows and barriers created by beaver dams. Numbers of juvenile rainbow trout and brown trout collected by electrofishing in the lower 2,000 feet of the creek during 1982 are shown in Table 3-22. The only known forage species present in the stream is the mottled sculpin.

Table 3-22. Numbers of juvenile rainbow trout and brown trout sampled in Cottonwood Creek during 1982.

Date Sampled	Rainbow trout		Brown trout	
	Number	Average Length (in.)	Number	Average Length (in.)
5/14/82	3	--	0	--
7/21/82	47	2.53	1	2.05
10/22/82	64	3.45	1	4.65

#### WILDLIFE:

Big game species found in the drainage include white-tailed deer, mule deer, elk, moose, bighorn sheep, antelope, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. The lower 1.5 miles of the stream provide fair waterfowl habitat. Bald eagles, ospreys and other raptors are known to frequent the stream corridor. Peregrine falcons have been released within 1.5 miles of the mouth of Cottonwood Creek in an attempt to establish a breeding population.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 90-foot section of Cottonwood Creek located near the Beartooth Management Area headquarters (Sec. 31B, T14N, R2W). Four riffle cross sections were established. The WETP program was calibrated to field data at flows of 0.3, 5.4 and 12.4 cfs.

The relationship between wetted perimeter and flow for a composite of the 4 riffle cross sections is shown in Figure 3-15. Lower and upper inflection points occur at approximate flows of 0.6 and 1.0 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population as well as to provide adequate spawning and rearing habitats for adfluvial trout from Holter Reservoir. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 1.0 cfs (724 A.F./yr.)

# COTTONWOOD CREEK

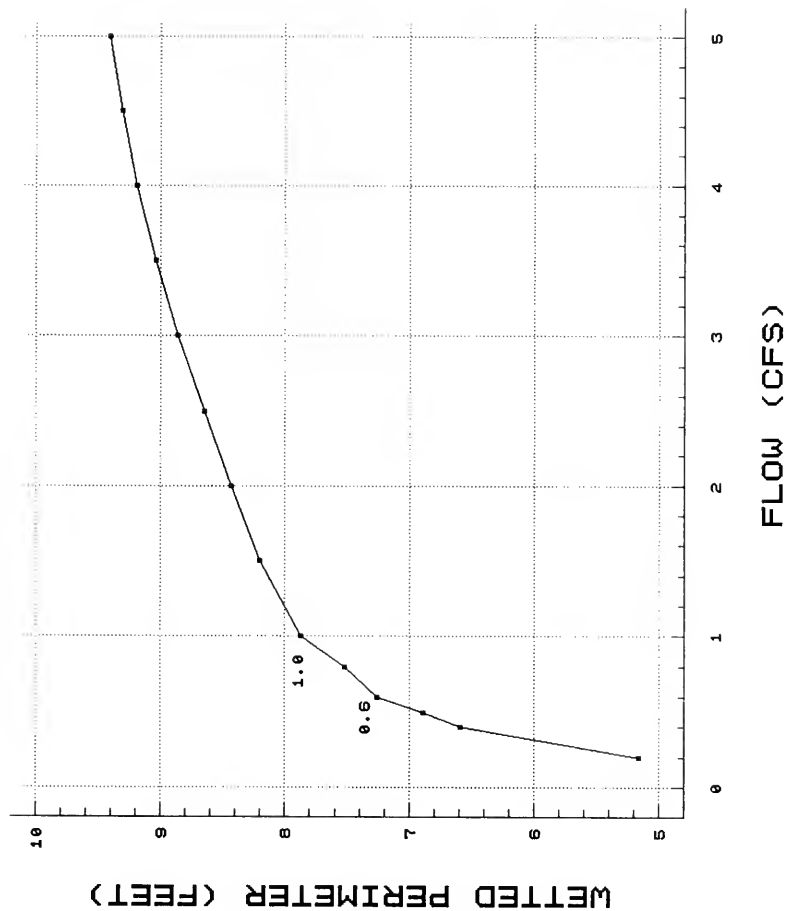


Figure 3-15. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Cottonwood Creek.



Little Prickly Pear Creek Drainage,  
Wegner and Stickney creeks

Figure 3-16 is a map which shows the locations of the following streams discussed in this section.

Little Prickly Pear Creek  
Virginia Creek  
Canyon Creek  
Lyons Creek

Wolf Creek  
Stickney Creek  
Wegner Creek





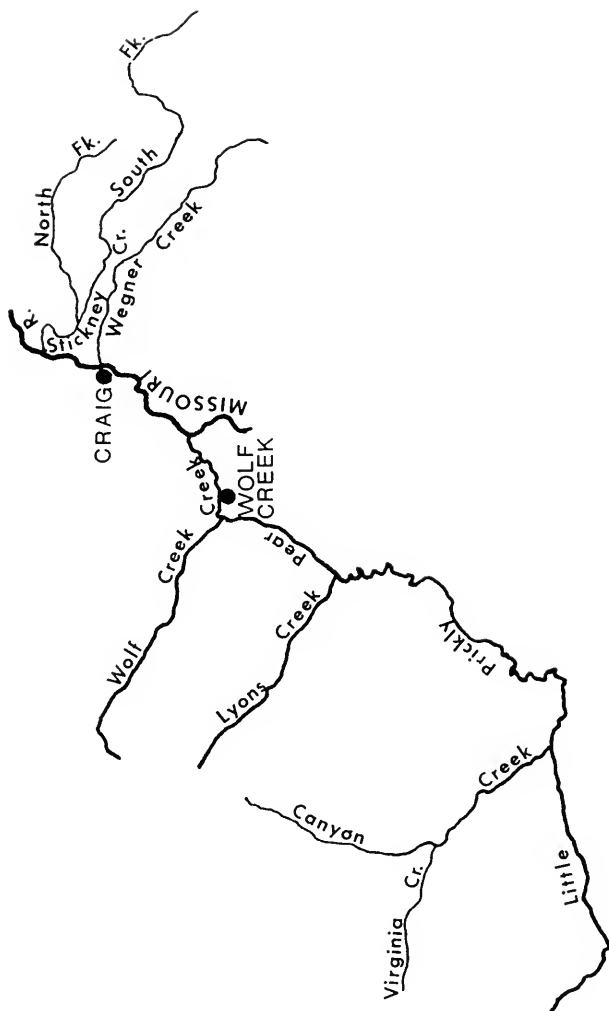


Figure 3-16. Location map for the Little Prickly Pear Creek drainage, Wegner and Stickney creeks.

**STREAM NAME:** Little Prickly Pear Creek

**DESCRIPTION OF THE BASIN:**

Little Prickly Pear Creek arises on the east slope of the Continental Divide in Lewis and Clark County approximately 30 miles northwest of Helena. It flows northwesterly for 35 miles to its confluence with the Missouri River about 2 miles downstream from Holter Dam. The stream flows through several distinct topographic zones, including mountainous headwaters, meadow and canyon areas. The creek drains an area of approximately 394 square miles, mostly consisting of grasslands with open stands of ponderosa pine. The average stream gradient is about 33 feet per mile. Stream width varies from 5 to 10 feet in the headwaters to about 45 feet near the mouth. Substrate varies from sand to gravel in the meadow zones and from gravel to cobble in the canyon zones.

A gravel county road parallels the stream from near its headwaters to the Sieben Ranch, and a railroad follows the stream from the Chevallier Ranch downstream. Downstream from the Sieben Ranch the stream is confined between an interstate highway, a railroad and a paved recreation road. Railroad and road construction have altered a major portion of the natural stream channel.

The major land use along the stream is agriculture, consisting of hay production and cattle and sheep grazing. Intensive agriculture as well as railway and road construction has denuded riparian vegetation along several sections of stream, resulting in serious bank erosion problems.

Numerous irrigation diversions located at various points along the entire stream can result in serious dewatering problems during low water years.

**STREAM NAME:** Little Prickly Pear Creek

**STREAM REACH:** #1. From the confluence of Canyon Creek to the confluence of Clark Creek -- 12.2 miles

**LOCATION:** Sec. 9, T12N, R5W to Sec. 9, T13N, R4W

**DESCRIPTION OF STREAM REACH:**

This reach of Little Prickly Pear Creek is 12.2 miles long and has an average width of about 24 feet. The stream passes through a wide meadow for about 5 miles before entering a narrow mountain canyon where it flows for another 6 miles. The lower end of the reach flows through a short mountain meadow zone. A graveled county road and a railroad parallel much of this reach. Riparian vegetation consists primarily of willows interspersed with alder, red dogwood and occasional clumps of cottonwoods. Dense bank vegetation borders the stream along the meadow zones. Railway construction in 1887 altered about 1/3 of the stream within the mountain canyon zone, greatly reducing the vegetative cover along this stretch. Much of the stream habitat in the altered sections has still not recovered sufficiently to support trout populations comparable to those found in natural sections.

Major tributaries to this reach of Little Prickly Pear Creek are Canyon and Big Sheep creeks. Several other small tributaries are present but generally go dry by mid-summer. The total drainage area of this reach is 270 square miles.

USGS flow records are available for 2 sites within the reach. The gauge at stream mile 14.2 (near the downstream boundary of the reach) was operated from April, 1962 to September, 1967. The mean annual flow for the 5 years of record was 69.4 cfs. The minimum flow during this period was 6.2 cfs in August, 1963. The mean annual flow for a 13-year period of record at the gauge at stream mile 24.8 (near the upstream boundary of Reach #1) was 48.2 cfs. Mean monthly flows ranged from 12 cfs (for August) to 179 cfs (for May). Base winter flow was 23 cfs. The fact that August is typically the lowest flow month of the year demonstrates the severity of summer flow depletions in Reach #1.

**GAME FISH PRESENT:** Brown trout, rainbow trout, brook trout, mountain whitefish

**FISHERY:**

Brown trout are the most abundant salmonid species in Reach #1. They comprise about 52% of the game fish population, followed by rainbow trout (36%), brook trout (10%) and mountain whitefish (2%). Longnose and white suckers are abundant in the slower portions of the stream, primarily in the meadow zones.

Standing crops of trout in Reach #1 range from 40 to 226 pounds per acre (or about 31 to 235 pounds per 1,000 feet of stream), depending on the section sampled (Elser 1968). Those stream sections altered by man-caused activities support fewer trout than the natural, unaltered sections.

Spawning surveys conducted in the spring of 1988 determined that rainbow trout from the Missouri River migrate to and spawn in the lower end of the reach. However, beaver dams prevented these fish from moving very far into the reach. Numerous beaver dams in Reach #1, and low fall streamflows restrict brown trout spawning to the lower end of Little Prickly Pear Creek.

Reach #1 flows entirely through private lands. However, several areas of the stream are accessible and open to public fishing. There are no developed campgrounds or picnic areas along this reach, although off-road parking is allowed in several areas. This reach is moderately popular for local fishermen but does not receive as much angling pressure as Reach #2.

**WILDLIFE:**

White-tailed and mule deer occupy the brushy bottomland along this reach. Beaver, muskrat, raccoon and mink inhabit the riparian zone throughout the year. Ruffed grouse, Hungarian partridge and a variety of songbirds are seasonally found along the stream. Mallards occasionally frequent this reach of stream.

**WETTED PERIMETER:**

Cross-sectional data were collected in a stream section near the center of Reach #1 (Sec. 11, T12N, R5W). Three riffle

cross sections were established. The WETP program was calibrated to field data collected at flows of 32.8 and 99.2 cfs.

The wetted perimeter-flow relationship for the composite of 3 riffle cross sections (Figure 3-17) shows lower and upper inflection points at approximate flows of 12 and 22 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout populations; to provide spawning and rearing habitat for rainbow and brown trout from the Missouri River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 22 cfs (15,927 A.F./yr.)

# LITTLE PRICKLY PEAR CREEK (reach 1)

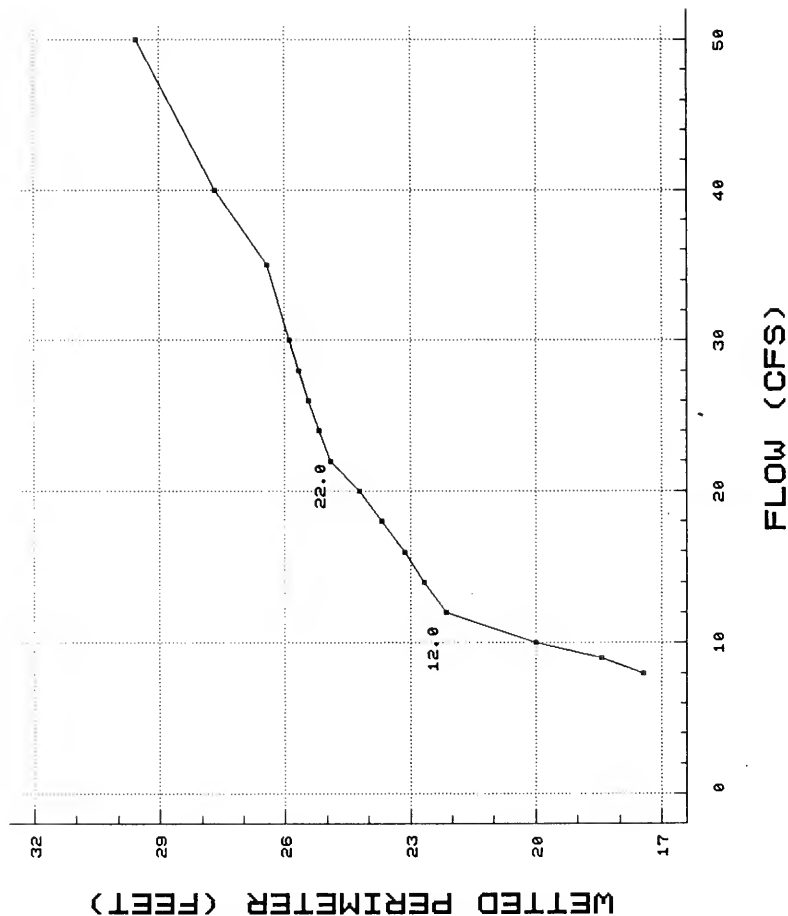


Figure 3-17. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Reach 1 of Little Prickly Pear Creek.

**STREAM NAME:** Little Prickly Pear Creek

**STREAM REACH:** #2. From the confluence of Clark Creek to the mouth  
-- 13.4 miles

**LOCATION:** Sec. 9, T13N, R4W to Sec. 29, T15N, R3W

**DESCRIPTION OF STREAM REACH:**

This reach of Little Prickly Pear Creek is 13.4 miles long and has an average width of about 45 feet. The stream flows through a narrow mountain canyon paralleled by a railroad, an interstate highway and a recreation road. Over 80 percent of Reach #2 was altered for interstate highway construction. Consequently, bank vegetative cover is sparse along much of the stream. In areas that have not been altered, dense clumps of cottonwoods and willows are found along the banks. Altered streambanks have been armored with large rock riprap. Rock deflectors were installed in many of the altered segments and pools have developed below them. During extremely dry years, irrigation diversions totally dewater a section in the lower 2 miles of the reach.

Major tributaries to Reach #2 are Lyons, Sheep, Little and Wolf creeks. Lower portions of Sheep and Little creeks usually go dry every year. The drainage area above the lower boundary of this reach is 386 square miles.

Short-term flow records are available for a USGS gauge site at stream mile 3.2 near the downstream boundary of Reach #2. The mean annual flow for a 5-year period of record (1963-67 water years) was 129 cfs. Mean monthly flows ranged from 51 cfs (January) to 391 cfs (May).

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish

**FISHERY:**

Rainbow trout are the dominant game fish in Reach #2, comprising about 78% of the total trout numbers. Brown trout are the other common game fish, followed by a few brook trout and mountain whitefish. White suckers, longnose suckers and mottled sculpins are also present.

In 1980, population estimates were made in 3 study sections in Reach #2 (Lere 1982). Estimated numbers of trout age 1+

and older (about 5 inches and longer) in the 3 sections ranged from 286 to 361 per 1,000 feet of stream. Pounds of trout per 1,000 feet ranged from 36.8 to 83.5. The study section that was rechanneled (altered) and confined as a result of highway construction and which contained no mitigative habitat structures supported the lowest population.

A 1969 population estimate in a 2,545-foot section within the Wolf Creek Canyon showed 297 brown and rainbow trout 4.0 inches and longer, weighing 82.4 pounds, per 1,000 feet of stream.

Little Prickly Pear Creek also provides important spawning and rearing habitat for migratory brown and rainbow trout from the Missouri River. Based on recapture data for rainbow trout marked at a trap installed at the mouth of Little Prickly Pear Creek in the spring of 1988, it was estimated that 15,000 rainbow migrated up the stream to spawn (Leathe, Hill and Wipperman 1988). These fish ranged from about 10 to 20 inches in length with an average size around 16 inches. Spawning redds were observed throughout Reach #2.

A substantial brown trout run also occurs in Little Prickly Pear Creek, but this run has not been quantified. Large numbers of white and longnose suckers move up the stream during the spring spawning season, and mountain whitefish migrate up the stream in the fall.

Public access to Reach #2 is excellent. Upon completion of Interstate Highway 15, old U.S. Highway 91 was converted into a recreation road and several picnic and parking areas were developed along it. Data from the 1982-86 statewide fishing pressure surveys indicated that an average of nearly 2,800 angler-days were expended on Little Prickly Pear Creek (McFarland 1989). Observations reveal most fishing pressure occurs in Reach #2.

#### **WILDLIFE:**

Both white-tailed and mule deer are found along this reach, but because most of Reach #2 is sandwiched between highways and a railroad, use of the riparian area by big game animals is limited. Mink, muskrat, beaver and raccoons frequent the stream corridor. Various species of songbirds seasonally frequent the riparian zone and a few Hungarian partridge and pheasants are found near the lower end. Mallards and mergansers occasionally nest along this reach of stream. At times, large numbers of mallards are found on the stream during cold periods in the fall.



#### **WETTED PERIMETER:**

Cross-sectional data were collected in a section of stream near the downstream boundary of Reach #2 (Sec. 2, T14N, R4W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 18.3, 33.0, 38.0 and 182.0 cfs.

The wetted perimeter-flow relationship for the composite of 5 riffle cross sections (Figure 3-18) shows upper and lower inflection points at approximate flows of 20 and 70 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to sustain existing resident trout populations; to maintain spawning and nursery habitats for migrant trout from the Missouri River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 70 cfs (50,678 A.F./yr.)

# LITTLE PRICKLY PEAR CREEK (reach 2)

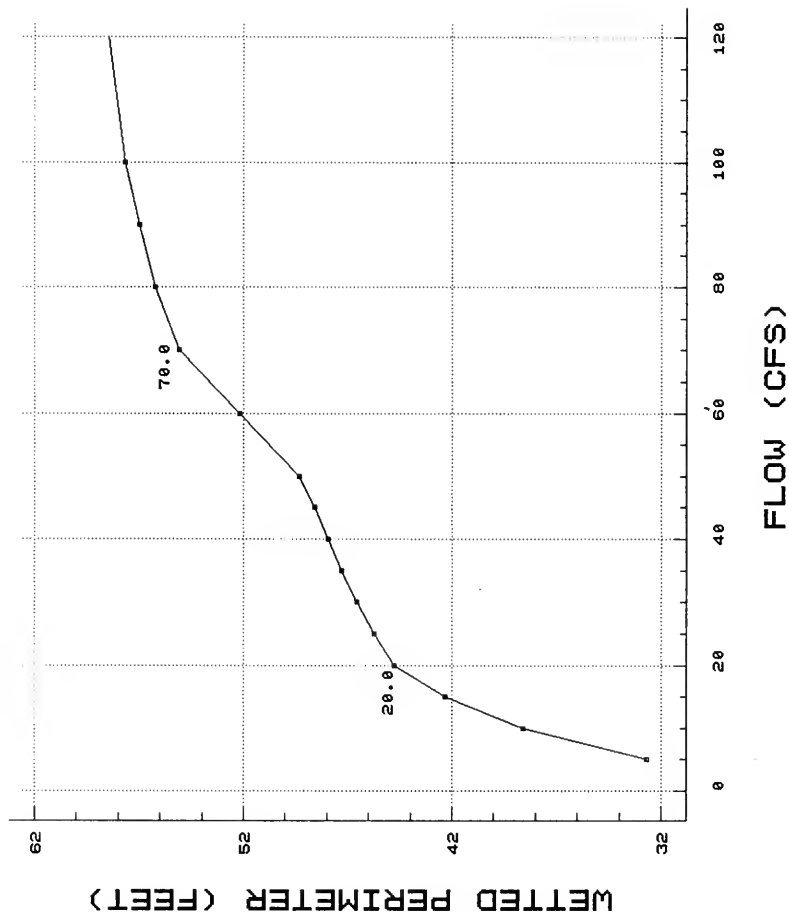


Figure 3-18. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 2 of Little Prickly Pear Creek.

**STREAM NAME:** Virginia Creek

**STREAM REACH:** Headwaters to mouth -- 8.0 miles

**LOCATION:** Sec. 16A, T13N, R7W to Sec. 15D, T13N, R6W

**DESCRIPTION OF STREAM REACH:**

Virginia Creek originates near the Continental Divide at Stemple Pass and flows easterly to its confluence with Canyon Creek. The elevation of the stream ranges from approximately 5,600 feet at the headwaters to 4,700 feet at the mouth. The mean gradient of the stream is about 2.1%. Virginia Creek flows through a narrow mountain canyon for its entire length. The narrow riparian zone is dominated by willows, water birch, cottonwoods and conifers. Major tributaries include Gould and Trout creeks.

Virginia Creek drains mostly forest lands. Land use in the basin primarily consists of grazing, mining and recreation. Land ownership in the drainage is approximately 20% private and 80% public (Helena National Forest and Bureau of Land Management). Approximately 5 miles of the stream corridor is in private ownership. Virginia Creek has been substantially altered by both mining and road construction. Access is provided by a public road that parallels the stream for its entire length.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout

**FISHERY:**

A 500-foot section of Virginia Creek located just upstream from the mouth of Trout Creek (Sec. 16A, T13N, R6W) was sampled by electrofishing on August 13, 1987. Streambed substrate in this section consisted of gravel and cobble with some silt in the pools. Water birth, willows and scattered cottonwoods provide a good stream canopy, but much of the smaller streamside vegetation has been destroyed by grazing. Overhanging bushes and abundant instream woody debris provide good fish habitat.

Brook trout and rainbow trout were collected in this section. Brook trout comprised 76% of the catch (Table 3-23). One 12-inch brown trout was collected just upstream from the sampling section while testing the electrofishing equipment, but no brown trout were collected from the 500-foot section itself. Numerous mottled sculpins were the only other fish

species observed. The two-pass method (Leathe 1983) was used to estimate the trout population in this section of stream (Table 3-24).

Table 3-23. Summary of electrofishing catch for 500 feet of Virginia Creek sampled August 13, 1987.

Species	Number Captured	Length Range (in.)
Brook trout	118	1.6-11.6
Rainbow trout	37	3.4-9.6

Table 3-24. Estimated trout populations in 500 feet of Virginia Creek sampled August 13, 1987. (80% confidence intervals in parentheses.)

Species	Length group (in.)	Number per 550 ft.
Brook trout	1.6-11.6	123 ( $\pm$ 4)
Rainbow trout	3.5-9.6	40 ( $\pm$ 4)
Combined trout	1.6-11.6	163 ( $\pm$ 6)
Combined trout	> 6.0	27 ( $\pm$ 1)

#### WILDLIFE:

Big game species found in the drainage include mule deer, elk, moose, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Waterfowl use is very limited.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 220-foot section of Virginia Creek located 0.8 miles upstream from the confluence with Canyon Creek (Sec. 15B, T13N, R6W). Four riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 4.3, 14.8 and 48.9 cfs.

The relationship between wetted perimeter and flow for a composite of the 4 riffle cross sections is shown in Figure 3-19. Lower and upper inflection points occur at approximate flows of 6.0 and 11.0 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population and to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 6.0 cfs (4,344 A.F./yr.)

The flow level specified by the upper inflection point appears to be high compared to water normally available in the basin. The Virginia Creek channel was altered in the past by dredging. Apparently more flow is required to maintain riffle habitat in this altered channel than was required in the natural channel. The lower inflection point of 6 cfs is being requested because it is more realistic in comparison to normal water availability.

# VIRGINIA CREEK

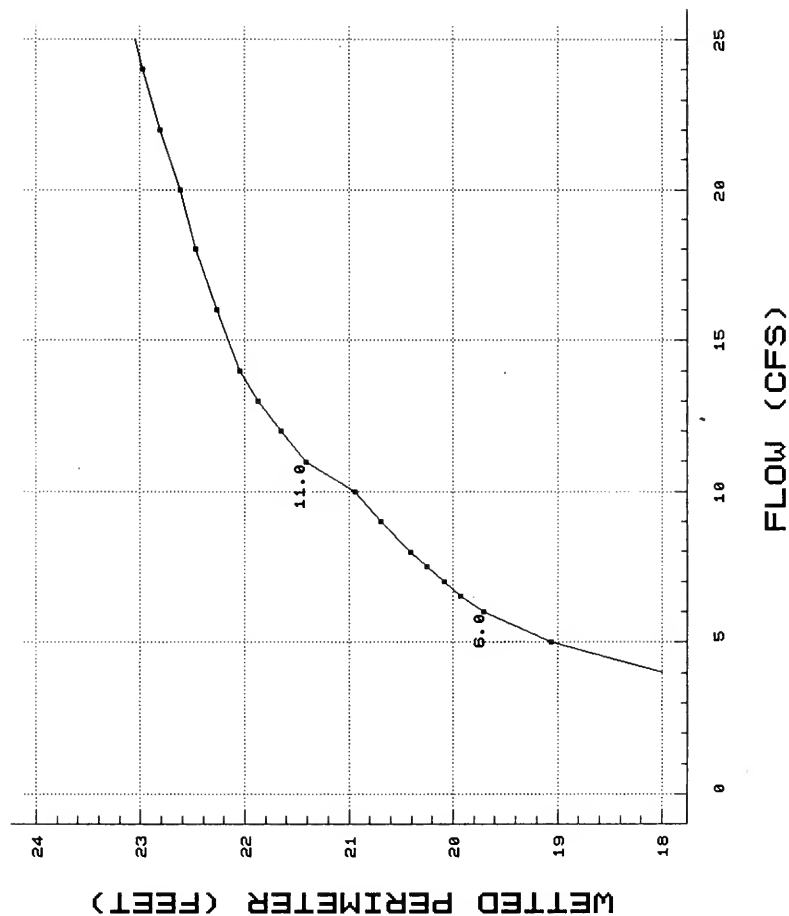


Figure 3-19. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Virginia Creek.

**STREAM NAME:** Canyon Creek

**STREAM REACH:** Headwaters to mouth -- 17.3 miles

**LOCATION:** Sec. 35D, T15N, R6W to Sec. 9B, T12N, R5W

**DESCRIPTION OF STREAM REACH:**

Canyon Creek originates near the Continental Divide between Flesher Pass and Rogers Pass and flows southerly to its confluence with Little Prickly Pear Creek. The elevation of the stream ranges from approximately 5,700 feet at the headwaters to 4,275 feet at the mouth. The mean gradient of the stream is about 1.6%. From the headwaters, Canyon Creek flows through a narrow mountain canyon to a point approximately 14.0 miles downstream. Exiting the canyon, the stream flows out into a broadened floodplain for about 3.5 miles to its confluence with Little Prickly Pear Creek. The narrow riparian zone in the mountain canyon is dominated by willows and cottonwoods that are interspersed with conifers. The riparian zone in the broadened floodplain is dominated by willows. Numerous beaver dams are found throughout the length of the stream. Virginia Creek is the major tributary to Canyon Creek.

The headwaters of Canyon Creek drain mostly forest lands while the lower 10.0 miles of stream drain mostly agricultural lands. Land use in the basin primarily consists of recreation, grazing and irrigated farming. Land ownership is approximately 60% private and 40% public (Helena National Forest). Approximately 12.5 miles of the stream corridor is privately owned.

Canyon Creek has been altered by both road construction and agricultural practices. The lower reaches of the stream are often severely dewatered during the summer irrigation season. Access is provided by Highway 279 that parallels the stream for about 10.0 miles.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

A 500-foot section of Canyon Creek located just downstream from the mouth of Rattlesnake Creek (Sec. 25A, T13N, R6W) was sampled by electrofishing on August 14, 1987. This section contained several well developed pools separated by shallow

runs. Undercut banks and overhanging vegetation provided good fish habitat. Streambed substrate consisted of cobble and gravel.

Rainbow trout made up 49% of the total catch, with the remainder about equally divided between brown trout and brook trout (Table 3-25). The large number of small fish observed indicates that this section of stream provides important rearing habitat for all three species of trout. Numerous beaver dams in the reach of stream below this point apparently prevent migratory fish from reaching this section during most years. The two-pass method (Leathe 1983) was used to estimate trout populations. Poor efficiency in capturing small trout made it impossible to estimate total trout numbers. Table 3-26 shows the population estimate for trout greater than 3.0 inches in length. Mottled sculpins were abundant and were the only other fish species observed.

Table 3-25. Summary of electrofishing catch for 500 feet of Canyon Creek sampled August 14, 1987.

Species	Number Captured	Length Range (in.)
Rainbow trout	103	1.2-11.2
Brown trout	60	1.5-13.6
Brook trout	49	2.2-8.0

Table 3-26. Estimated trout populations in 500 feet of Canyon Creek sampled August 14, 1987. (80% confidence intervals in parentheses.)

Species	Length group (in.)	Number per 550 ft.
Combined trout	> 3.0	116 ( $\pm$ 18)
Combined trout	> 6.0	30 ( $\pm$ 3)

#### WILDLIFE:

Big game species found in the drainage include white-tailed deer, mule deer, elk, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Waterfowl use is limited.



#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 350-foot section of Canyon Creek located immediately upstream from the Highway 279 bridge (Sec. 31A, T13N, R5W). Three riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 5.4, 8.3 and 12.8 cfs.

The relationship between wetted perimeter and flow for a composite of the 3 riffle cross sections is shown in Figure 3-20. Lower and upper inflection points occur at approximate flows of 5.5 and 10.0 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout populations and to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 10.0 cfs (7,240 A.F./yr.)

# CANYON CREEK

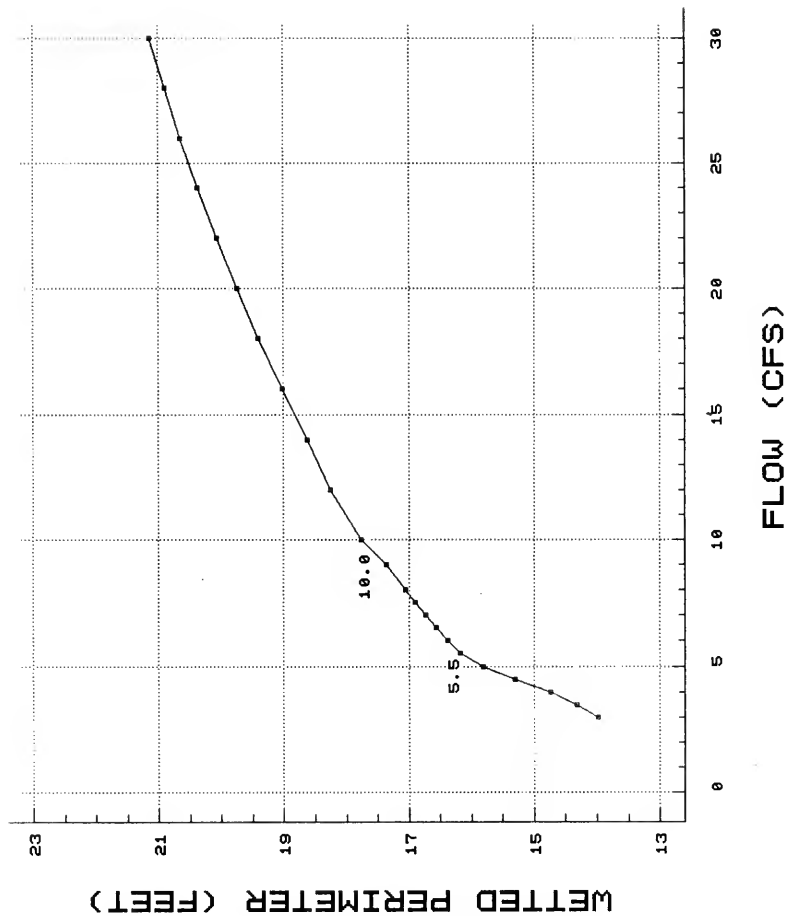


Figure 3-20. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Canyon Creek.

**STREAM NAME:** Lyons Creek

**STREAM REACH:** Headwaters to mouth -- 10.2 miles

**LOCATION:** Sec. 36A, T15N, R6W to Sec. 28C, T14N, R4W

**DESCRIPTION OF STREAM REACH:**

Lyons Creek originates near the Continental Divide north of the city of Helena and flows southeasterly to its confluence with Little Prickly Pear Creek. The elevation of the stream ranges from approximately 4,700 feet at the headwaters to 3,750 feet at the mouth. The mean gradient of the stream is about 1.8%. Lyons Creek flows through a narrow mountain valley for its entire length. The riparian zone is dominated by willows, chokecherry and cottonwoods interspersed with conifers. Numerous beaver dams are found throughout the upper 7 miles of the stream.

Land use in the drainage basin primarily consists of grazing and recreation. Ownership in the basin is checkerboarded with approximately 60% under private ownership and 40% under public ownership (state lands). Access is provided by an unimproved road that parallels the stream from the mouth to the headwaters. Access is controlled by private landowners.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

Lyons Creek contains an excellent resident trout population for a stream of its size. It also provides important spawning and rearing habitat for trout from the Missouri River and Little Prickly Pear Creek.

A 500-foot section of Lyons Creek just upstream from Interstate 15 was sampled by electrofishing on August 31, 1987. Substrate in this section was gravel and small cobbles. The riparian overstory was limited, but small overhanging bushes and accumulated instream woody debris provided excellent fish habitat in the many small pools present. Attached aquatic vegetation also provided cover for small fish. A second section located just below a new bridge approximately 3 miles above the mouth was shocked in the spring of 1988 to search for marked rainbow spawners from the Missouri River.

Rainbow were the most numerous trout species collected in 1987, however, 66% of these were less than 3 inches long. Brown trout made up 38% of the catch with a good size distribution of fish up to 16 inches long. Brook trout comprised a small part of the population. Sampling results for the summer of 1987 are summarized in Table 3-27.

Table 3-27. Summary of electrofishing catch for 500 feet of Lyons Creek sampled August 31, 1987.

Species	Number Captured	Length Range (in.)
Rainbow trout	264	1.9-12.1
Brown trout	169	1.7-16.0
Brook trout	12	2.5-7.5

Table 3-28 shows results of a two-pass method (Leathe 1983) population estimate made for the same 500-foot section. Brook trout numbers were too low to make a separate estimate, but they are included under combined trout.

Table 3-28. Estimated trout populations in 500 feet of Lyons Creek sampled August 31, 1987. (80% confidence intervals in parentheses.)

Species	Length group (in.)	Number per 550 ft.
Rainbow trout	> 3.0	110 ( $\pm$ 12)
Brown trout	> 3.0	132 ( $\pm$ 3)
Combined trout	1.7-16.0	584 ( $\pm$ 50)
Combined trout	> 3.0	243 ( $\pm$ 10)
Combined trout	> 6.0	71 ( $\pm$ 2)

A spawning survey conducted on April 28, 1988 found redds and migratory rainbow from the mouth of Lyons Creek to the first barrier beaver dam located approximately 3.0 miles upstream. A 1/4-mile section of stream was shocked just below this dam and 124 mature rainbow trout averaging 15.0 inches total length were collected. Of these, 11.3% were rainbow that had been marked at a trap at the mouth of Little Prickly Pear Creek earlier in the month. No effort was made to collect fish other than rainbow spawners in the spring of 1988, but smaller rainbow, brown trout and brook trout were observed. Twelve brown trout collected during this sampling averaged 10.5 inches long. The large number of small trout collected in the fall of 1987 showed that Lyons Creek is also an important rearing stream for both rainbow and brown trout.

Mottled sculpins were common in both shocking sections and were the only other fish species seen. The lower end of Lyons Creek is heavily posted against trespass which probably limits angler use, but the upper section of the stream receives considerable angler use.

#### **WILDLIFE:**

Big game species found in the drainage include white-tailed deer, mule deer, elk, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink and bobcat. Waterfowl use is very limited.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 250-foot section of Lyons Creek located just downstream from the Interstate Highway 15 bridge (Sec. 28C, T14N, R4W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 6.9, 16.3 and 33.0 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-21. Lower and upper inflection points occur at approximate flows of 6.0 and 10.0 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout fishery as well as to provide adequate spawning and rearing habitats for rainbow trout and brown trout which migrate into the stream from the Missouri River and Little Prickly Pear Creek. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 10.0 cfs (7,240 A.F./yr.)

# LYONS CREEK

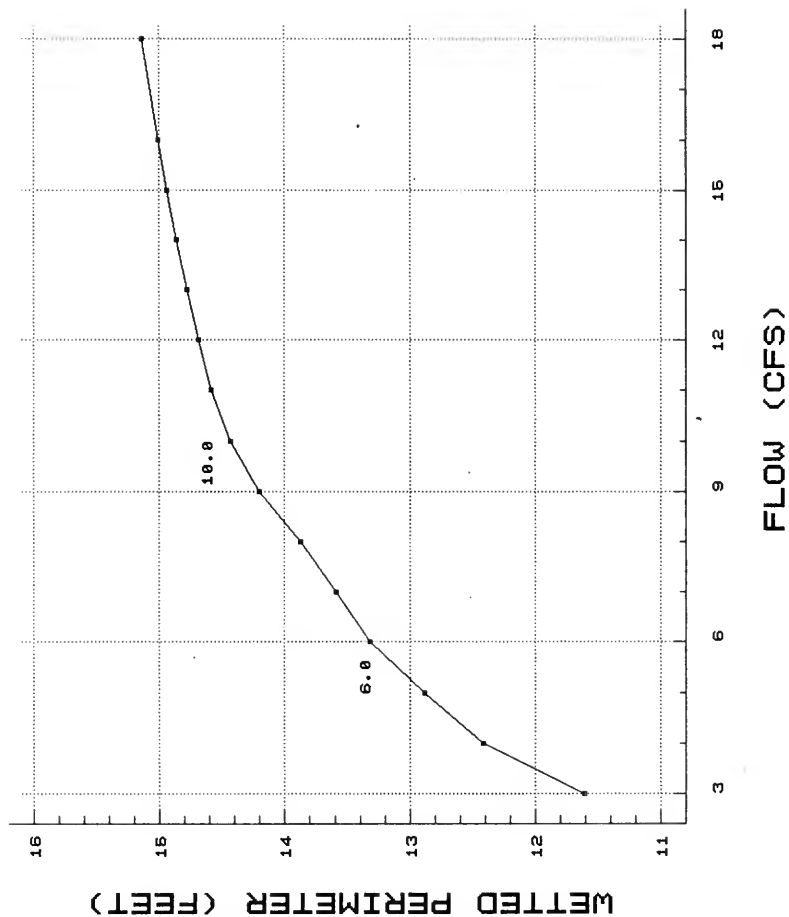


Figure 3-21. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Lyons Creek.

**STREAM NAME:** Wolf Creek

**STREAM REACH:** Headwaters to mouth -- 11.6 miles

**LOCATION:** Sec. 6D, T15N, R5W to Sec. 35C, T15N, R4W

**DESCRIPTION OF STREAM REACH:**

Wolf Creek originates approximately 10.0 miles northwest of the town of Wolf Creek and flows southeasterly to its confluence with Little Prickly Pear Creek. The elevation of the stream ranges from approximately 4,800 feet at the headwaters to 3,600 feet at the mouth. The mean gradient of the stream is about 2.0%. Wolf Creek flows through a mountain canyon for its entire length. The riparian zone is dominated by cottonwoods and willows.

Wolf Creek drains mostly hilly, open country that contains scattered timber. Grazing is the major land use in the basin, with some hayland found in the floodplain. Land ownership in the drainage is checkerboarded with approximately 75% in private ownership and 25% in public ownership (state lands). Wolf Creek has been altered by both road construction and encroachment from housing along the stream corridor. Several irrigation diversions also are found on the stream. Access is provided by State Highway 434 which parallels the creek from the mouth to a point 3.0 miles upstream and then by a private road which parallels the stream for its remaining length.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

A 500-foot section of Wolf Creek located approximately 2.0 miles upstream from the Interstate 15 bridge (Sec. 28D, T15N, R4W) was sampled by electrofishing on October 26, 1987. The stream in this section is deeply entrenched between steep grassy hills on the south and a hay meadow on the north. A limited amount of vegetation along the stream bank provides some cover. The section consisted of a series of riffles and runs. Substrate was gravel with limited cobble, boulders up to 8.0 inches in diameter and some bedrock. Siltation was evident but not excessive.

The sample section contained a substantial population of trout, but few larger fish were present. Rainbow trout comprised over 71% of the catch, followed by brown trout and then brook trout (Table 3-29). Mottled sculpins were numerous and were the only other fish species observed. Over 68% of the rainbow trout captured were less than 3.0 inches long and 77% of the brown trout were between 3.0 and 6.0 inches in length. It appears that Wolf Creek is an important rearing stream for both rainbow trout and brown trout. The two-pass method (Leathe 1983) was used to estimate the trout population in this section of Wolf Creek. Results of these estimates are shown in Table 3-30.

Table 3-29. Summary of electrofishing catch for 500 feet of Wolf Creek sampled October 26, 1987.

Species	Number Captured	Length Range (in.)
Rainbow trout	329	2.0-12.7
Brown trout	118	2.6-16.4
Brook trout	15	2.8-6.8

Table 3-30. Estimated trout populations in 500 feet of Wolf Creek sampled October 26, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	No. per 500 ft.
Rainbow trout	2.0 - 12.7	336 ( $\pm$ 4)
Brown trout	2.6 - 16.4	123 ( $\pm$ 4)
Brook trout	2.8 - 6.8	16 ( $\pm$ 2)
Combined trout	2.0 - 16.4	474 ( $\pm$ 5)
Combined trout	>3.0	233 ( $\pm$ 4)
Combined trout	>6.0	28 ( $\pm$ 1)

Wolf Creek also was sampled in late April, 1988 in a survey for spawning rainbow trout. Redds and mature rainbow trout were observed from just above the mouth to the first barrier beaver dam located approximately 2.4 miles upstream. More than 200 rainbow trout were congregated below the beaver dam indicating that the dam was acting as a barrier to spawning migrants. On April 27, 1988 a large number of rainbow trout were observed spawning in a gravel area located near the lower end of the same section sampled in the fall of 1987. Approximately 1/4 mile of this section was electrofished to look for rainbow trout that had been captured and marked in a spawning trap located in the mouth of Little Prickly Pear Creek. The sampling produced 145 mature rainbow trout, averaging 14.5 inches in total length. Nineteen of these fish had



been marked at the trap earlier in the spring indicating that migratory rainbow trout from the Missouri River utilize Wolf Creek for spawning.

#### **WILDLIFE:**

Big game species found in the drainage include white-tailed deer, mule deer, elk, black bear, and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver muskrat, mink and bobcat. Waterfowl use is limited.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 200-foot section of Wolf Creek located approximately 0.2 miles upstream from the confluence with Little Prickly Pear Creek (Sec. 35C, T15N, R4W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 4.4, 7.0 and 16.4 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-22. An upper inflection point occurs at an approximate flow of 7.0 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout fishery as well as to provide adequate passage, spawning and rearing habitat for rainbow trout and brown trout which migrate into the stream from the Missouri River and Little Prickly Pear Creek. Additionally, the flow is needed to protect the habitat for those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 7.0 cfs (5,068 A.F./yr.)

## WOLF CREEK

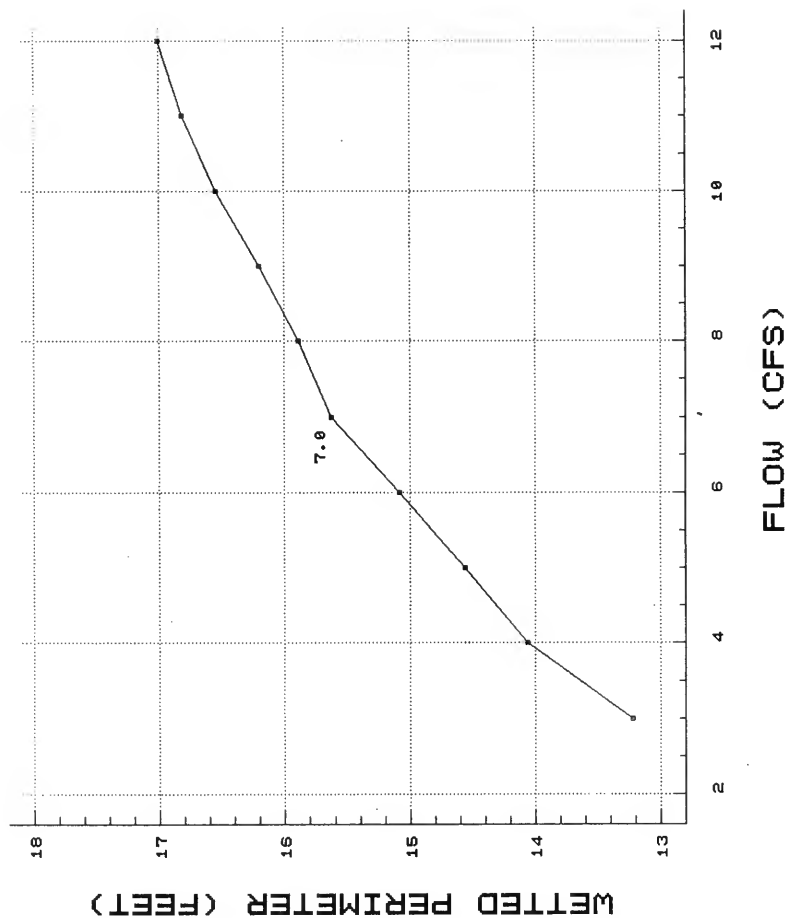


Figure 3-22. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Wolf Creek.

**STREAM NAME:** Wegner Creek

**STREAM REACH:** From the headwaters to the mouth -- 13.3 miles

**LOCATION:** Sec. 8B, T14N, R1W to Sec. 10A, T15N, R3W

**DESCRIPTION OF STREAM REACH:**

Wegner Creek originates at about 5,200 feet in the Big Belt Mountains just north of the Beartooth Wildlife Management Area. It flows northwest through a narrow mountain valley for approximately 13 miles before discharging into the Missouri River just downstream from the town of Craig. Average stream gradient is about 87 feet/mile. No major tributaries enter Wegner Creek.

Riparian vegetation consists of willows, rose and alder. Streambed substrate is cobble and gravel with some sediment. Beaver activity is common along the stream, with several large dams near the lower end.

Cattle grazing is the major land use in the drainage. Recreational use is minimal because the entire drainage is privately owned and access is extremely limited. A jeep trail parallels the stream for about 8 miles and crosses it several times.

Flow is intermittent in the lower 5 miles of Wegner Creek. Long sections of stream, especially just above the mouth, go dry during most years. No water is currently diverted from Wegner Creek for irrigation, but there is some evidence of past irrigation in the drainage.

**GAME FISH PRESENT:** Rainbow trout

**FISHERY:**

Restricted access to private property and a limited water supply has prevented the collection of any data on the resident fish population in Wegner Creek. There are probably some resident fish in the upper, perennially flowing section, but it is unlikely the lower intermittent section maintains much of a fishery.

Wegner Creek does appear to be an important spawning stream for rainbow trout from the Missouri River. An electrofishing survey in the lower section of Wegner Creek on April 6, 1981 collected 8 mature rainbow. Due to low spring flows in 1988, there was no water flowing at the mouth of Wegner Creek during the peak rainbow spawning period in April and early May. However, a helicopter survey conducted on the main Missouri River on May 3 estimated 200-300 rainbow redds in the river within 1/2 mile of the mouth of Wegner Creek. Since this was the only concentration of redds found between Cascade and Holter Dam, it appeared these fish were keying into Wegner Creek and were forced to spawn in the river when they could not migrate up the stream. Once water began to flow at the mouth of Wegner Creek in mid-May the lower 3 miles of stream was surveyed for spawning activities. Despite the fact that peak spawning was over, approximately 25 to 30 adult rainbow were observed; many of them on redds. Based on these observations, it appears there is a significant rainbow run into Wegner Creek during normal water years.

#### **WILDLIFE:**

Big game animals found in the drainage include white-tailed and mule deer, elk, moose, bighorn sheep, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, mink, muskrat and bobcat. Mallards, teal and mergansers use the many beaver ponds for nesting.

#### **WETTED PERIMETER:**

Because the only flows normally occurring in this reach of stream are spring runoff flows, it is important that a major portion of these flows be maintained. High flows are necessary for channel maintenance and to provide the best possible conditions for fish movement into the stream during the brief spring runoff period. These flow levels will help maintain fish passage both up and down stream.

Lack of access to private property and intermittent stream flow prevented the use of the wetted perimeter method on this stream. Flows are requested only for the 4-month spring runoff period because this is the only time of year when surface flows normally occur in this reach of Wegner Creek. These flows are requested primarily to maintain the rainbow trout spawning run from the Missouri River. The flows requested are the mean monthly flows determined by the USGS (1989) (see Appendix A).

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain fish passage and to maintain the channel in the intermittent section of Wegner Creek so adult rainbow can migrate upstream to spawn and so yearling and older rainbow can migrate back to the Missouri River. These flows will also help to maintain the riparian area in the lower section of Wegner Creek to benefit those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### FLOW REQUEST:

April 1 - April 30	--	8 cfs	( 476 A.F.)
May 1 - May 31	--	41 cfs	(2,521 A.F.)
June 1 - June 30	--	38 cfs	(2,261 A.F.)
July 1 - July 31	--	8 cfs	( 492 A.F.)

5,750 A.F./yr

The requested flow levels represent less than the 50th percentile flows for each month (the mean monthly flow lies somewhere between the 50th and 20th percentile flows). These flows will be available less than 5 years in 10 on the average. However, the requests are necessary to help ensure that flows are high enough during good water years to maintain the connection between the Missouri River and the perennial flow which occurs in upper Wegner Creek where a portion of the rainbow spawned are believed to reside until they can again return to the Missouri River during high flows. It is, therefore, necessary to request these flow levels even though they are not available every year.

**STREAM NAME:** Stickney Creek

**STREAM REACH:** From the confluence of the North and South Forks to the mouth -- 3.2 miles

**LOCATION:** Sec. 1A, T15N, R3W to Sec. 26C, T16N, R3W

**DESCRIPTION OF STREAM REACH:**

The North and South Forks of Stickney Creek originate at about 6,400 feet in the north end of the Big Belt Mountains. They flow in a westerly direction, converging at the base of the mountains about 1 mile west of the Missouri River. Stickney Creek then meanders through a wide foothill valley for 3.2 miles to its confluence with the Missouri River 3 river miles downstream from the town of Craig. Average gradient for this reach is about 49 feet/mile. No tributaries enter Stickney Creek below the convergence of the forks.

Riparian vegetation consists of willows, rose bushes and alders. Streambed substrate is cobble and gravel with some sediment.

Grazing is the major land use in the drainage. There has been considerable logging in the upper drainage and at least 1 private outfitter operates a hunting camp in this area. Almost the entire drainage is privately owned and public access is limited. An unimproved road parallels the stream from about 2.5 miles above the mouth to near the headwaters.

Flows in this entire reach are intermittent and go underground at numerous locations during much of the year. These intermittent flows continue approximately 2.5 miles up the South Fork and 1.5 miles up the North Fork. Above this, both forks contain perennial streams.

**GAME FISH PRESENT:** Rainbow trout, brook trout

**FISHERY:**

Stickney Creek is an important spawning stream for Missouri River rainbow trout. A short section of Stickney Creek, just above the mouth, was sampled by electrofishing in the spring of 1981. Thirty ripe and gravid rainbow trout were collected (Berg 1982). This indicates there can be a significant rainbow spawning run up Stickney Creek when water is available. The perennial section of the South Fork appears to be important in maintaining this spawning run. The lower

end of the South Fork, above its intermittent section, supports a good rainbow trout population. During normal spring flows, spawning fish migrate to this perennial section where they can spawn successfully. Young rainbow can remain in the South Fork for a year or more before returning to the Missouri with the next high spring flows.

The perennial sections of both forks support good resident trout populations. The South Fork contains predominantly rainbow trout in the lower end with the population shifting mostly to brook trout in the upper end. The North Fork is smaller than the South Fork and contains mostly brook trout.

#### **WILDLIFE:**

Big game animals found in the drainage include white-tailed deer and mule deer, elk, moose, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, mink, muskrat and bobcat. Waterfowl use is very limited.

#### **WETTED PERIMETER:**

Because the only flows normally occurring in this reach of stream are spring runoff flows, it is important that a major portion of these flows be maintained. High flows are necessary for channel maintenance and to provide the best possible conditions for fish movement into the stream during the brief spring runoff period. These flow levels will help maintain fish passage both up and down stream.

Lack of access to private property and intermittent flow patterns prevented the use of the wetted perimeter method on this stream.

Flows are being requested only for the 4-month spring runoff period because this is the only time of year when surface flows normally occur in this reach of Stickney Creek. These flows are requested primarily to maintain the rainbow trout spawning run from the Missouri River. The flows requested are the mean monthly flows determined by the USGS (see Appendix A).

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain fish passage in the intermittent section of Stickney Creek in the spring so adult rainbow can migrate upstream to spawn and so yearling and older rainbow can migrate back to the Missouri River. These flows will also help maintain channel characteristics as well as the riparian area in the lower section of Stickney Creek to benefit those wildlife species which depend upon the stream and its associated habitat for food, water and shelter.

#### FLOW REQUEST:

April 1 - April 30	--	7 cfs	( 417 A.F.)
May 1 - May 31	--	34 cfs	(2,091 A.F.)
June 1 - June 30	--	35 cfs	(2,083 A.F.)
July 1 - July 31	--	7 cfs	( 430 A.F.)

5,021 A.F./yr.

The requested flow levels represent less than the 50th percentile flows for each month (the mean monthly flow lies somewhere between the 50th and 20th percentile flows). These flows will be available less than 5 years in 10 on the average. However, the requests are necessary to help ensure that flows are high enough during good water years to maintain the connection between the Missouri River and the perennial flow which occurs in upper Stickney Creek drainage where a portion of the rainbow spawned are believed to reside until they can again return to the Missouri River during high flows. It is, therefore, necessary to request these flow levels even though they are not available every year.



## Dearborn River Drainage and Sheep Creek

Figure 3-23 is a map which shows the location of the following streams discussed in this section.

Dearborn River  
Middle Fork Dearborn River  
South Fork Dearborn River  
Flat Creek  
Sheep Creek

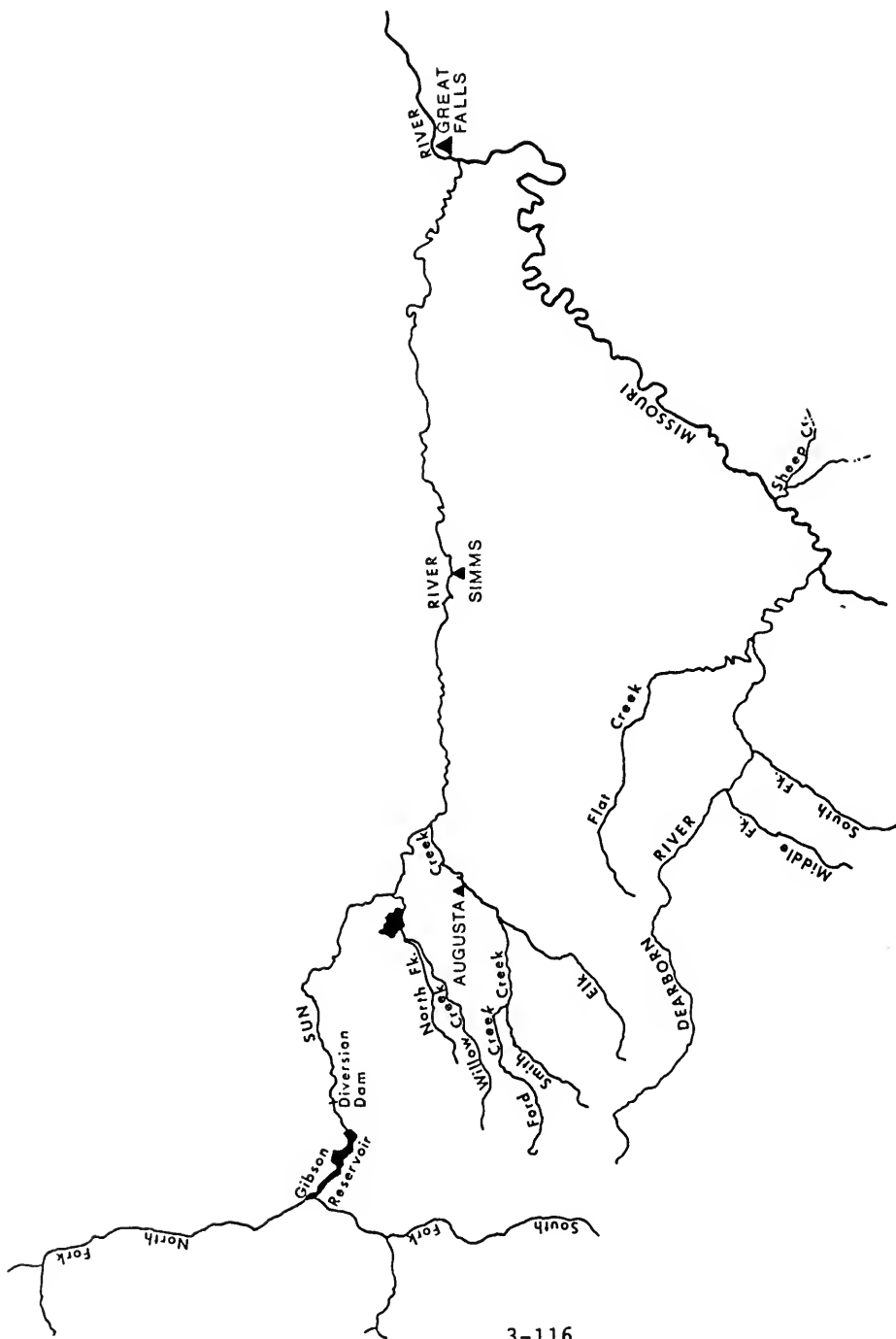


Figure 3-23. Map locating the Dearborn River Drainage and Sheep Creek.

**STREAM NAME:** Dearborn River

**STREAM REACH:** From the headwaters to the mouth - 68.5 miles

**LOCATION:** Sec. 13D, T18N, R10W to Sec. 19D, T16N, R2W

**DESCRIPTION OF THE STREAM REACH:**

The Dearborn River is located in Lewis and Clark County in central Montana. The elevation of the stream ranges from 7,400 feet at the headwaters to 3,515 feet at the mouth. It originates on the Continental Divide near Scapegoat Mountain, flows eastward through the mountains and then southeast through the foothills, entering the Missouri River a few miles north of the town of Craig. The Middle and South Forks of the Dearborn originate east and south of Rogers Pass. Both forks flow in a northeasterly direction and enter the main Dearborn River a few miles east of the Rocky Mountains front.

The upper 20 miles of the Dearborn River are on U.S. Forest Service land, while the remaining portion of the river is primarily on private land. The most popular recreational floating stretch lies between the State Highway #287 crossing and the river's mouth. This section is entirely on private land, access is limited and the floating season is short.

The Dearborn has many of the habitat problems characteristic of streams east of the Continental Divide. Irrigation dewatering and stream alteration have taken their toll on the stream's fish populations. Much of the land along the lower reaches of the river has been subdivided. There is also a subdivision on the upper reach of the river near the mouth of Falls Creek. The upper Dearborn River is typical of a mountain stream with fast water and a number of large pools. Here the substrate consists largely of boulders, rubble and gravel. Land use includes logging, livestock grazing and recreation. The river below Highway 287 flows through a deep canyon. Here the river is somewhat slower and is characterized by large, deep holes separated by riffle areas. The substrate in this reach is characterized by cobble and gravel. Land use includes recreation, livestock grazing, hay and grain production. Major tributaries include Falls Creek, South Fork Dearborn, Middle Fork Dearborn, and Flat Creek.

The USGS has operated two gauges on the Dearborn River. A gauge 18 miles upstream from the mouth of the Dearborn River recorded a mean annual flow of 218 cfs for the 24 year period from 1945-69. Mean monthly flows ranged from 41 cfs in September to 519 cfs in June for the 1969 water year. The

second gauge, 45 miles upstream from the mouth of the Dearborn, recorded a mean annual flow of 116 cfs for the years 1921-23, 1929-32 and 1934-53.

**GAME FISH PRESENT:** Rainbow trout, brook trout, brown trout, mountain whitefish

**FISHERY:**

Rainbow trout are the predominant game fish species in the river. Most of the resident fish range in size from 8 to 12 inches, although occasionally a larger rainbow is caught. Brown trout are found in the lower river and will average somewhat larger than the rainbow. Brook trout are present in the headwaters. The statewide fishing pressure mail survey indicates that the Dearborn River supported an average annual use of 1,676 angler days for the period 1982-86 (McFarland 1989).

Fish traps were placed near the mouth of the Dearborn River during the spring of 1988 to capture rainbow trout migrating upstream from the Missouri River to spawn. The traps were operated between March 16 and May 5 with a total of 2,361 mature rainbow trout being marked as they passed upstream through the trap. Three sections of the river ranging between two and three miles in length were electrofished between April 25 and 29 to determine the percentage of marked fish and thus, trapping efficiency. These sections were located approximately 18, 28, and 43 river miles upstream from the mouth of the Dearborn. Substantial numbers of previously marked fish were captured in each section. From this information, an estimated 20,000 Missouri River rainbows spawned in the Dearborn River drainage during 1988.

Approximately 1,200 rainbows were tagged as they passed through the traps. Fourteen tags were recovered and reported by anglers by January, 1989. All of these fish were caught in the Missouri River and the majority were taken between the Craig Bridge (5.5 river miles upstream from the Dearborn confluence) and Pelican point (12.2 river miles downstream from the Dearborn).

The Dearborn River also supports heavy spawning use by longnose and white suckers from the Missouri River. During the spring of 1988, 5,331 mature long nose suckers were passed through the trap. The run peaked in mid-April.

A helicopter survey of 42 miles of the Dearborn River was conducted on April 28, 1988 to determine the distribution and intensity of rainbow trout spawning. Visibility was excellent and spawning areas were easily identified because of

abnormally low water due to near-drought conditions. Approximately 6,000 redds were observed. However, this is an approximate count due to an extensive amount of redd superimposition in nearly every spawning riffle. Based on trapping results, electrofishing surveys and aerial observations of spawning fish on redds, it was estimated that spawning was about 2/3 complete on April 28. Redd density was highest between river mile 10 and 20 (219 to 232 redds per mile) but spawning was fairly evenly distributed (123 to 232 redds per mile) in the entire lower 30 miles. Spawning use declined significantly above river mile 35 and appeared negligible above river mile 40. The spring 1988 surveys indicate that the Dearborn River is the most important spawning stream for rainbow trout which inhabit the blue ribbon Missouri River between Holter Dam and Cascade.

A trap was installed in the Dearborn River in the fall of 1988 approximately 3.5 miles upstream from the mouth. It was operated for two days per week from late September through the end of October to monitor for migratory brown trout from the Missouri River. One 22.5-inch brown trout was captured the first night the trap was operated, no other brown trout were collected. Five rainbow trout were captured; probably resident fish moving within the area.

A substantial whitefish run was observed; 3,457 whitefish were handled during ten nights of trapping. The peak of this run occurred about the third week in October.

#### **WILDLIFE:**

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, grizzly bear and mountain lion. The grizzly bear, a threatened species, inhabits the upper drainage on a year-round basis. Game birds utilizing the drainage include ruffed, blue and spruce grouse in the upper reaches and Hungarian partridge and sharp-tailed grouse in the lower reaches. Some waterfowl use occurs on the river, including nesting by mergansers. Other important wildlife species include beaver, muskrat, mink, lynx, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on a 350-foot section of the Dearborn River (Sec. 24A, T16N, R3W) about .7 miles upstream from the confluence with the Missouri River. Four

cross sections were established. The WETP program was calibrated to field data collected at flows of 24.6, 93.2 and 144.6 cfs.

The relationship between wetted perimeter and flow for a composite of the four riffle cross sections is shown in Figure 3-24. Lower and upper inflection points occur at approximate flows of 50 and 110 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population, to protect spawning and rearing habitats in this critical Missouri River rainbow trout spawning tributary, and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 110 cfs (79,636 A.F./yr.)

# DEARBORN RIVER

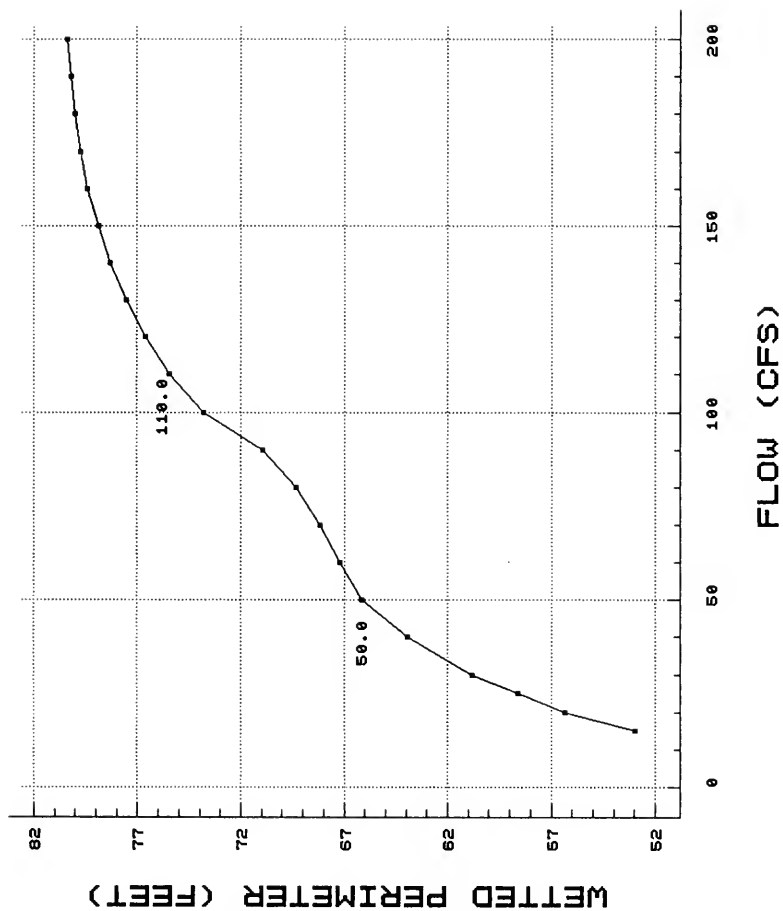


Figure 3-24. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in the Dearborn River.

**STREAM NAME:** Middle Fork Dearborn River

**STREAM REACH:** From the headwaters to the mouth - 13.7 miles

**LOCATION:** Sec. 4C, T15N, R6W to Sec. 21A, T17N, R5W

**DESCRIPTION OF STREAM REACH:**

The Middle Fork of the Dearborn originates along the Continental Divide near Rogers Pass on State Highway 200 then flows northeast to its confluence with the Dearborn River. It flows for about 10 miles through a deeply entrenched mountain valley, then enters a prairie section where it meanders through a mature bottom between gently rolling hills. Tributaries to this reach include Catherine, Handgrove and Skunk Creeks.

The riparian zone in the upper reach is confined to a narrow band of willows along the stream with many bedrock outcrops and a heavy conifer overstory. Streambed substrate is boulder and cobble with numerous large trees in the stream channel. Riparian vegetation in the valley section consists of willows, rose and scattered cottonwoods.

Much of the riparian area in the lower section of stream has been impacted by cattle grazing and several areas have been cleared right to the bank for hay production. Numerous beaver dams are present, especially near the center of the valley. Streambed substrate is gravel, cobble and boulders with considerable silt. Numerous bedrock outcrops protrude out of the hills along the lower end of the stream. Many of these extend across the stream and create partial barriers during low water.

Land ownership is about 14% public and 86% private. Some access is allowed on private land. Major land uses in the upper drainage include logging and recreation. Grazing and hay production are the major uses in the lower drainage.

Highway 200 parallels the Middle Fork for the upper 11 miles, then crosses the stream at the upper end of the prairie section. A county road and one private road cross the stream in the center of the valley section and a gravel road parallels the stream for a couple of miles. Several private irrigation diversions can seriously impact stream flows during low water years.



**GAME FISH PRESENT:** Rainbow trout, brook trout

**FISHERY:**

On October 20, 1987 a 500-foot section of the Middle Fork upstream from the bridge on the Ingerstall Ranch (Sec. 30C, T17N, R5W) was sampled by electrofishing. Pools, overhanging woody debris and undercut banks provided fish habitat in this section. The riparian area consisted of grass banks with scattered willows and cottonwoods. Substrate was gravel and cobble.

Rainbow and brook trout were collected, with rainbow constituting 97% of the catch. Numerous mottled sculpins and one 8-inch white sucker were also observed. Electrofishing survey data are summarized in Table 3-31.

Table 3-31. Summary of electrofishing catch for 500 feet of the Middle Fork Dearborn River sampled October 20, 1987.

Species	Number Captured	Length Range (in.)
Rainbow trout	238	2.1 - 16.2
Brook trout	7	3.7 - 10.3

The two-pass method (Leathe 1983) was used to estimate the total trout population in this 500-foot section of stream (Table 3-32).

Table 3-32. Estimated trout population in 500 feet of the Middle Fork Dearborn river sampled October 12, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 500 ft.
Combined trout	2.1 - 16.2	265 ( $\pm$ 11)
Combined trout	$\geq$ 3	189 ( $\pm$ 8)
Combined trout	$\geq$ 6	25 ( $\pm$ 2)

The Middle Fork downstream from State Highway #434 was walked in mid-April, 1988 to look for spawning rainbow. A beaver dam located approximately 1/4 mile above the mouth appeared to be a complete barrier to upstream migration. Twenty-three redds and numerous 12 to 16-inch rainbow were observed between the

beaver dam and the mouth of the river. Trapping data from the mouth of the Dearborn River indicated the major rainbow spawning run was just starting at this time. Numerous beaver dams just above Highway #434 probably prevent fish from moving above this area even during high water years.

#### **WILDLIFE:**

Big game animals utilizing the stream and riparian area include white-tailed and mule deer, elk, antelope, black bear and mountain lion. Upland game birds include blue, ruffed and spruce grouse, found mostly in the upper drainage. Furbearers include beaver, muskrat, mink and bobcat. Coyotes and various raptors also utilize the area. Some waterfowl use the stream as a resting area during spring and fall migrations, and mallards, teal and Canada geese nest in the beaver ponds in the lower reach.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in an approximate 450-foot section of the Middle Fork located just upstream from the bridge on the Ingerstall Ranch (Sec. 30, T17N, R5W). Three riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 13.4, 16.6 and 49.2 cfs.

The relationship between wetted perimeter and flow for a composite of the three riffle cross sections is shown in Figure 3-25. An upper inflection point occurs at an approximate flow of 9.5 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout fishery; to protect spawning and rearing habitats for rainbow trout that migrate into the stream from the Missouri and Dearborn rivers; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 9.5 cfs (6,878 A.F./yr.)

# MIDDLE FORK DEARBORN RIVER

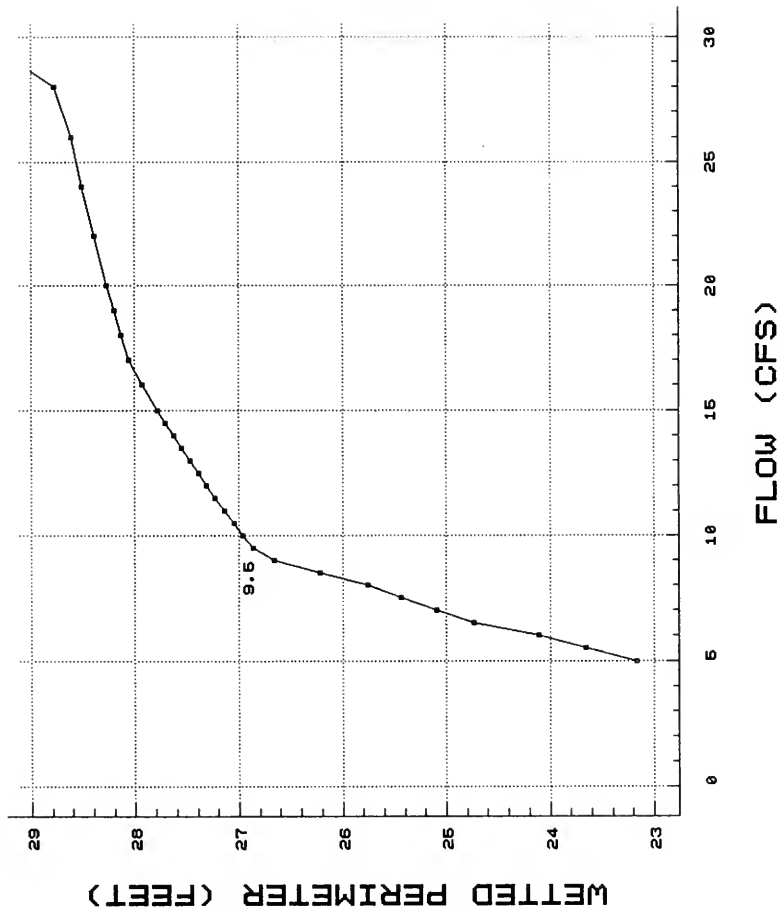


Figure 3-25. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in the Middle Fork of the Dearborn River.

**STREAM NAME:** South Fork Dearborn River

**STREAM REACH:** From the headwaters to the mouth -- 14.6 miles

**LOCATION:** Sec. 25A, T15N, R6W to Sec. 25C, T17N, R5W

**DESCRIPTION OF STREAM REACH:**

The South Fork of the Dearborn originates in the steep mountains along the Continental Divide approximately 5 miles south of Rogers Pass on State Highway #200. From the mountains, the stream flows northeast through a short foothill section then enters a rolling prairie section where it meanders through an entrenched channel to its confluence with the Dearborn River. Tributaries to the South Fork include West Prong, Cave, Routt, Roberts, Johnson, Bassette and Borrell Creeks. The riparian area consists of conifers in the mountainous reach, willows, cottonwoods and alder in the foothills area, and willows, rose bushes and scattered cottonwoods in the prairie region.

The riparian zone downstream from Highway #434 is in very poor condition due to extensive cattle grazing along the banks. There are many raw, sluffing banks. Streambed substrate ranges from boulder and cobble in the upper reach to boulder and gravel in the lower valley. Thick silt layers are common in pools and behind beaver dams. Numerous bedrock outcrops occur in the lower valley with several extending across the stream. Beaver dams are common along the stream with a large concentration just above Highway #434.

Land ownership is approximately 12% National Forest; the remainder is private. Access to private lands is usually granted upon request.

Major land uses outside the riparian zone include grazing, hay production and recreation. State Highway #434 crosses the South Fork approximately 3 1/4 miles above the mouth and a gravel road follows the stream upstream from this highway. There are three irrigation diversions in this reach plus a fourth one that can divert most of the stream right at the mouth. These diversions can seriously dewater the South Fork during the irrigation season.

**GAME FISH PRESENT:** Rainbow trout, brook trout

## FISHERY:

A 500-foot section of the South Fork was electrofished on September 24, 1987. The shocking section, located on the Frank Thompson property (Sec. 15B, T16N, R5W), extended upstream starting 100 feet below the Thompson bridge. This section contained riffle-run-pool habitat and substrate was gravel and silt. The riparian area was in good condition, consisting of grass, willows and rose bushes with a few scattered cottonwoods. Overhanging vegetation and channel debris provided good fish habitat.

Rainbow trout, brook trout and mottled sculpins were collected. Rainbow constituted over 96% of the trout sampled. Electrofishing survey data are summarized in Table 3-33.

Table 3-33. Summary of electrofishing catch for 500 feet of the South Fork Dearborn River sampled September 24, 1987.

Species	Number Captured	Length Range (in.)
Rainbow trout	301	2.1 - 11.9
Brook trout	11	3.2 - 9.0

The two-pass method (Leathe 1983) was used to estimate the total trout population in this section of stream (Table 3-34).

Table 3-34. Estimated trout population (rainbow and brook trout) in 500 feet of the South Fork Dearborn River sampled September 24, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 500 ft.
Combined trout	$\geq 3$	193 ( $\pm 5$ )
Combined trout	$\geq 6$	48 ( $\pm 1$ )
Combined trout	2.1 - 11.9	333 ( $\pm 10$ )

Over 40% of the rainbow collected were less than 3 inches long, indicating that natural reproduction was good and that this stream provides important trout rearing habitat.

The section of the South Fork downstream from Highway #434 was walked in mid-April 1988 to look for spawning rainbow. Two large beaver dams located approximately one mile above the mouth appeared to be complete barriers to upstream movement. Twelve redds and numerous 12 to 16-inch rainbow were observed

downstream from these dams. Trapping data from a trap located near the mouth of the Dearborn River indicated that the major rainbow spawning run was just starting at this time.

The large number of beaver dams located above Highway #434 probably prevents migrating fish from moving above this point during most years.

#### **WILDLIFE:**

Big game animals utilizing the stream and riparian area include white-tailed and mule deer, elk, antelope, black bear and mountain lion. Upland game birds include blue, ruffed and spruce grouse. Furbearers include beaver, muskrat, mink and bobcat. Coyotes and various raptors also utilize the area. Some waterfowl use the stream as a resting area during spring and fall migrations and some duck nesting occurs in the beaver ponds along the stream.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in an approximate 600-foot section of the South Fork located above and below the bridge on the Frank Thompson ranch (Sec. 15, T16N, R5W). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 9.7, 15.5 and 42.6 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-26. Lower and upper inflection points occur at approximate flows of 5.5 and 11.5 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout fishery; to protect spawning and rearing habitats for rainbow trout that migrate into the stream from the Dearborn River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 11.5 cfs (8,326 A.F./yr.)

# SOUTH FORK DEARBORN RIVER

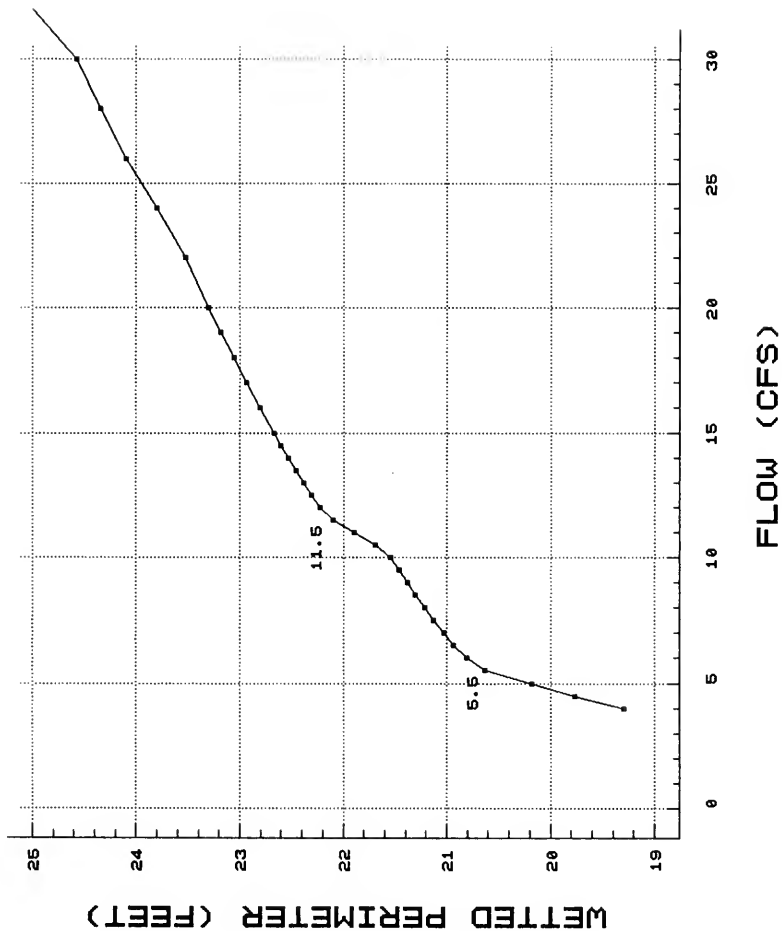


Figure 3-26. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in the South Fork of the Dearborn River.

**STREAM NAME:** Flat Creek

**STREAM REACH:** From the headwaters to the mouth - 32 miles

**LOCATION:** Sec. 7C, T18N, R6W to Sec. 29C, T17N, R3W

**DESCRIPTION OF STREAM REACH:**

Flat Creek originates as a meadow stream from groundwater along the base of the eastern front just north of Bean Lake. It flows east to southeast for about 20 miles, then turns south to enter the Dearborn River approximately five miles downstream from State Highway #287.

Tributaries to Flat Creek include Hogan, Black Rock, Myles, Henery, Willow and Slew creeks.

Flat Creek meanders through a wide valley between rolling prairie hills for most of its length, entering a narrow gorge for the lower 6.5 miles. Average stream gradient is 31.2 feet/mile. The riparian zone is in poor condition and consists mostly of grass with some scattered willows. Grazing and hay cutting occurs right up to the stream banks along much of the stream. Streambed substrate is composed of boulders and gravel, but most of the bottom is covered with a thick layer of silt. Land use beyond the riparian zone include grazing, hay production and some grain farming. Land ownership is 100% private. Public access is severely restricted by adjacent landowners.

Extensive irrigation occurs throughout the entire Flat Creek drainage. From May through September, Flat Creek is used as an irrigation canal to transport water diverted from the upper Dearborn River. This results in a totally unnatural flow pattern in Flat Creek, with the greatest flows in most of the creek occurring during the irrigation season. These abnormally high flows have caused serious bank erosion along much of Flat Creek, and have resulted in a serious sediment problem, especially in the lower half of the stream.

**GAME FISH PRESENT:** Rainbow trout, brook trout, brown trout, mountain whitefish



## FISHERY:

A 1,000-foot section of Flat Creek just downstream from the bridge on the Art Thompson property (Sec. 35D, T18N, R4W) was sampled by electrofishing on October 30, 1987. An additional 500 feet above the Thompson bridge and 400 feet on the Milford Hutterite property (Sec. 10D, T18N, R5W) were sampled on June 3, 1988. Rainbow and brown trout and one whitefish were collected in the lower section while brook and rainbow trout were collected in the upper section. Large numbers of longnose dace, white suckers and lake chubs were observed in both sections and mottled sculpins were common in the upper section. The electrofishing survey data are summarized in Tables 3-35 and 3-36. Due to low numbers of trout, a population estimate could not be obtained in either section.

Table 3-35. Summary of electrofishing catch for 1,500 feet of Flat Creek sampled October 30, 1987 and June 3, 1988.

Species	Number Captured	Length Range (in.)	Mean Length (in.)
Rainbow trout	11	3.3 - 13.8	6.5
Brown trout	4	4.4 - 5.9	4.9

Table 3-36. Summary of electrofishing catch for 400 feet of Flat Creek sampled June 3, 1988.

Species	Number Captured	Length Range (in.)	Mean Length (in.)
Brook trout	7	5.7	5.5 - 8.7
Rainbow trout	3	6.3	5.6 - 7.0

The serious sediment problem and the continuous flow of turbid water throughout the irrigation season have probably had a major impact on the trout fishery in Flat Creek.

There is an extensive run of rainbow trout from the Missouri River up the Dearborn River in the spring. It is likely that some of these rainbow migrate up Flat Creek, but this has not been documented. If rainbow spawning does occur in Flat Creek, egg survival may be limited by the large amount of sediment present.

#### **WILDLIFE:**

Big game species found in the drainage include mule deer, white-tailed deer, and antelope. Hungarian partridge are the resident game bird. Other wildlife include beaver, muskrat, mink, bobcat, coyote, and various raptors. Waterfowl use is limited.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 125-foot section of Flat Creek just upstream from the bridge on the Art Thompson ranch (Sec. 35, T18N, R4W). Three riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 7.7 and 33.3 cfs.

The relationship between wetted perimeter and flow for a composite of the three riffle cross sections is shown in Figure 3-27. Lower and upper inflection points occur at approximate flows of 7.5 and 10 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout fishery during periods when supplemental irrigation water is not being transported down Flat Creek. These flows will also help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 7.5 cfs (5,430 A.F./yr.)

The lower inflection point flow is requested because of the lower level of aquatic habitat of Flat Creek.

# FLAT CREEK

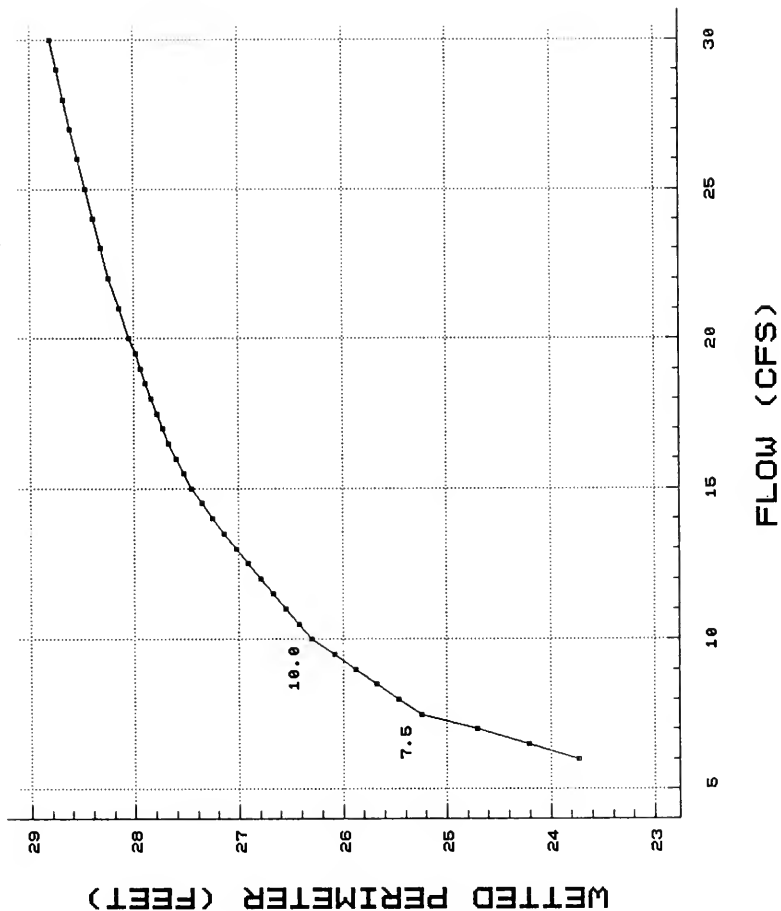


Figure 3-27. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Flat Creek.

**STREAM NAME:** Sheep Creek

**STREAM REACH:** From the headwaters of the South Fork of Sheep Creek to the mouth - 12.2 miles

**LOCATION:** Sec. 25D, T16N, R1W to Sec. 36C, T17N, R2W

**DESCRIPTION OF STREAM REACH:**

Sheep Creek as described herein includes the South Fork Sheep Creek which flows 10.2 miles from its headwaters to its confluence with the North Fork Sheep Creek to form Sheep Creek, which then flows 2.0 miles to its confluence with the Missouri River. Sheep Creek originates in the northwest corner of the Big Belt Mountains and flows northeast through Cascade County in central Montana to its confluence with the Missouri River. The elevation of the stream ranges from 5800 feet at the headwaters to 3375 feet at the mouth.

The upper 6 miles of the South Fork is a high gradient mountain stream flowing through a rugged rocky canyon which has little vegetation. In the lower 6 miles, the valley floor opens up and the stream flows to the Missouri River through cottonwood bottoms with a more moderate gradient. The upper half of the drainage is checkerboard in ownership (Bureau of Land Management and private land) while the lower half of the drainage is entirely on private land. The only major tributary to Sheep Creek is the North Fork of Sheep Creek. Substrate in the stream consists largely of boulders, rubble and cobbles in the upper half, changing to cobbles and gravel in the lower half. Riparian vegetation is limited in the upper half while the lower half is predominately cottonwoods. Hunting and logging are the predominant land uses. There are several summer homes along the stream in the lower half of the drainage. There is limited livestock grazing in the drainage and some water is diverted out of the drainage for hay production.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

A county road parallels the lower 1/2 mile of Sheep Creek, providing good access for fishermen. The 1982-86 statewide mail survey shows that Sheep Creek provides up to 800 angler days of use each year (McFarland 1989). Traps were placed near the mouth of Sheep Creek during the springs of 1986 and

1987 to capture and mark rainbow trout migrating upstream from the Missouri River to spawn. Upstream and downstream fish traps were operated between April 11 and May 4, 1986 and from March 7 through May 8, 1987. A total of 699 rainbow trout spawners nine inches and longer were marked in 1986 as they passed through the lower trap. A population of 4,400 spawners was estimated based on 55 recaptures of post-spawners passing down through the upper trap. In 1987, a total of 1,139 rainbow trout spawners nine inches and longer were marked as they passed upstream through the lower trap. A population estimate of 3,555 spawners was based on 426 recaptures out of 1,341 post-spawners handled. The average size of the spawners using Sheep Creek is 16.4 inches.

A sample of fish from both the 1986 and 1987 spawning runs was tagged as they emigrated from Sheep Creek. The majority of the tags returned have come from the downstream areas of the Missouri River within 15 miles of Sheep Creek. Some have been recovered as far away as Great Falls, 65 river miles downstream. These data indicate that Sheep Creek is a critical Missouri River rainbow trout spawning tributary that is particularly important to fish residing in the river downstream from Sheep Creek where spawning habitat is limited. Past survey work also indicates this is also an important spawning stream for river populations of brown trout and mountain whitefish.

The resident fish population in Sheep Creek has not been sampled, but is known to consist of rainbow, brown and brook trout.

#### **WILDLIFE:**

Big game species using the area include mule and white-tailed deer, elk, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Little waterfowl use occurs on Sheep Creek. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on two 250-foot sections of Sheep Creek (Sec. 1B, T16N, R2W) separated by 200 yards approximately 3/4 mile upstream from its confluence with the Missouri River. Four cross sections were established. The WETP program was calibrated to field data collected at flows of 4.9, 18.4 and 53.3 cfs.

The relationship between wetted perimeter and flow for a composite of the four riffle cross sections is shown in Figure 3-28. Lower and upper inflection points occur at approximate flows of 9 and 22 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to protect this critical Missouri River spawning tributary, maintain the existing resident trout population and help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1 - December 31-- 22 cfs (15,927 A.F./yr.)

# SHEEP CREEK

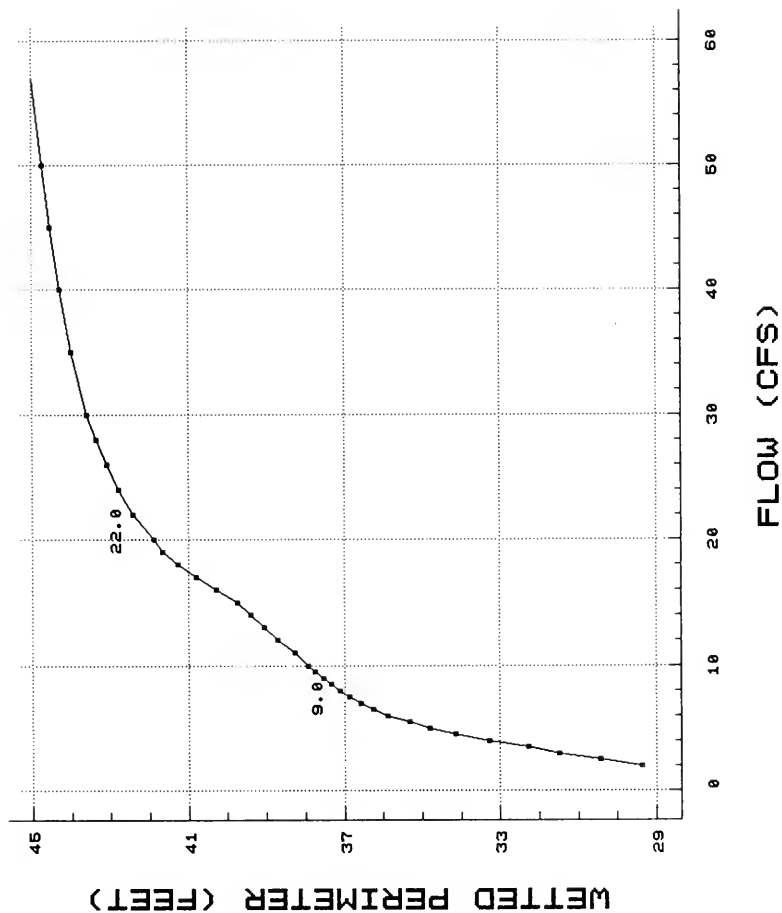


Figure 3-28. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Sheep Creek.





## Smith River Drainage

Figure 3-29 is a map which shows the location of the following streams discussed in this section:

Smith River  
South Fork Smith River  
North Fork Smith River  
Newlan Creek  
Big Birch Creek  
Sheep Creek

Eagle Creek  
Rock Creek  
Tenderfoot Creek  
North Fork Deep Creek  
Hound Creek

Problems with water quality in the river system are attributed to agricultural runoff and irrigation return flows which cause increases in salinity, nutrient levels and sediment. These in turn contribute to high water temperatures and turbidities and lowered dissolved oxygen levels.

These water quality problems, along with the serious stream dewatering that occurs, can have serious impacts on the fishery throughout the basin.

The Musselshell Basin supports a wide variety of fish and wildlife which provide an important recreational resource for the region. The fishery in the Musselshell River can be separated into three biotic reaches or zones: (1) An upper coldwater zone, (2) a middle transitional zone and, (3) a lower warmwater zone. The stream reach write-ups and flow requests were developed around these three zones.

**STREAM NAME:** Musselshell River

**STREAM REACH:** #1. From the confluence of the North and South forks to Deadmans Basin Diversion -- 55.3 miles

**LOCATION:** Sec. 6C, T8N, R12E to Sec. 8B, T7N, R17E

**DESCRIPTION OF STREAM REACH:**

The upper Musselshell River flows eastward from the confluence of the North and South forks near Martinsdale to the Deadmans Basin Diversion Dam midway between Harlowton and Shawmut. It is a high quality trout stream meandering through dense riparian bottomland intermingled with hay meadows. The channel is generally 50-100 feet wide at a gradient of about 13 feet/mile over gravel and sand substrate and intermittent sandstone outcrops.

The drainage area above Harlowton is 1,125 square miles. Major tributaries include Little Elk, Miller, Big Elk, Lebo, and American Fork creeks arising from the Crazy Mountains to the south, and Daisy Dean, Haymaker, Hopley, and Antelope creeks arising from the Little Belt Mountains to the north. Bair Reservoir on the North Fork and Martinsdale Reservoir on the South Fork markedly influence streamflows. Diversions upstream from Harlowton (including the forks) irrigate about 37,000 acres (58 square miles) of land. They include at least 10 ditch systems with capacities of 15-400 cfs each as well as numerous pump operations.

At the lower end of this reach is the Deadmans Basin Diversion Dam. The Deadmans Basin Canal has a capacity of 600 cfs which is diverted into offstream storage at Deadmans Basin Reservoir. The reservoir, built in 1941, has a capacity of 76,900 acre-feet and covers 2,120 acres when full. Water diverted into Deadmans Basin during the non-irrigation season is returned via the Barber and Careless Creek canals during the irrigation season.

A USGS stream gauge is maintained at the town of Harlowton. It provides a 77-year period of record (1907 to 1987). Average annual flow during that period was 163 cfs with the lowest monthly base flows averaging 59 to 82 cfs during August through February. Other USGS gauge stations are located upstream on the North and South forks and downstream near Roundup.

**STREAM NAME:** Smith River

**DESCRIPTION OF THE BASIN:**

The Smith River drainage lies in west-central Montana, almost due south of Great Falls between the Big Belt Mountains on the west and the Little Belt and Castle mountains on the east. The drainage is approximately 75 miles in length and the width varies from 3 to 45 miles. The total area is slightly over 2,000 square miles. The elevation of the floor of the drainage varies from 3,350 to 5,400 feet. The highest mountain peaks range from 8,500 to 9,500 feet.

The Smith River is formed by the junction of the North and South Forks of the Smith River about 4 miles southwest of the town of White Sulphur Springs. The North Fork drains part of the southwest slopes of the Little Belt Mountains and the northwest slopes of the Castle Mountains. The South Fork originates along the southwest flank of the Castle Mountains and from the bench lands between the Castle and Big Belt mountains. The mainstem of the Smith River then meanders northwesterly about 41 miles through a broad upper valley before entering a deep mountain canyon near the confluence of Sheep Creek. The river twists north for approximately 45 miles between high limestone cliffs and conifer and grass-covered mountains before flowing another 12 miles through foothill grasslands. After Hound Creek enters the Smith, the river meanders another 23 miles through a relatively narrow agriculturally developed valley flanked by rolling grasslands until it joins the Missouri River near the town of Ulm about 11 miles west of Great Falls.

Habitat conditions are variable between the different sections. Stream and riparian habitat is in very good condition in the upper reach, above the canyon. This section of stream almost resembles a large spring creek as it meanders through sedge and hay meadows. It has a well developed riparian zone predominated by willows and contains good instream cover consisting of rooted aquatic vegetation and undercut banks. Substrate in this section is sand and gravel.

In the canyon section, the riparian zone becomes confined between steep limestone walls. Riparian vegetation consists of grasses and substrate is gravel and cobble.

In the grassland reach below the canyon, habitat is generally poor. Much of this section is heavily grazed and riparian vegetation is very limited. Instream habitat is poor due to annual dewatering. Downstream from Eden Bridge, a number of

steep erosive banks occur along the stream. Substrate ranges from gravel in the upper end to sand in the lower end where the gradient decreases.

Numerous tributaries originate in the Big Belt and Little Belt mountains to join the Smith River. Some of the major tributaries originating in the Big Belt Mountains are Birch, Camas, Beaver, Rock, and Hound creeks. Those from the Little Belt Mountains are Newlan, Sheep, Eagle and Tenderfoot creeks and the Dry Fork of the Smith River.

Approximately 2,500 persons reside within the Smith River drainage. A major highway system makes the area accessible to the surrounding urban areas which have a population of over 150,000 people.

Land ownership in the drainage is about 70% private and 30% public (Forest Service and State). Public access to the river is restricted throughout the drainage. Access across private land is often difficult to obtain, especially in the canyon section. The Montana Department of Fish, Wildlife and Parks (DFWP) owns two fishing access sites on the upper river and leases a small site near the confluence of Hound Creek to accommodate floaters. As a result of the limited access, a large part of the recreational use of the river involves float fishing and boating on the 61-mile-long section of river from Camp Baker to Eden Bridge. The DFWP and the Forest Service maintain numerous camps along this segment of river that are accessible only by boat. The floating season usually begins about mid-May and continues until about mid-August (in most years) when water levels become too low for floating. Use of this section of river has increased greatly in recent years.

In the early 1860s, the discovery of gold in the surrounding mountains stimulated a heavy influx of miners. As gold was depleted and mining operations abandoned, farming and ranching began to take over as the predominant land use in the basin and they remain so today. Logging and recreation are other important land uses in the drainage.

The mean discharge of the Smith River for an 18-year period of record at the USGS gauge near Eden (river mile 27) was 338 cfs. Flows ranged from 3.1 to 12,300 cfs. Flows at this gauge reflect the upstream dewatering that occurs during the summer irrigation season. The mean discharge at the USGS gauge near Fort Logan (river mile 83.7) was 173 cfs for the period of record (1977-87). The flows ranged from 28 to 4,600 cfs. Upstream dewatering due to summer irrigation is also reflected at this gauge.

Waters in the Smith River drainage have been appropriated for irrigation and domestic uses. As in other areas of the state, appropriations are often several times the amount of water actually present. The dewatering of the Smith River during the summer irrigation season is probably the greatest factor limiting present game fish populations.

Presently, the water quality of the Smith River is generally good. A future threat to water quality is the poorly planned recreational homesite development that is occurring along the river. The loose alluvial materials found at many of the good construction sites will result in the rapid leaching of sewage effluent into the river.

Elevated summer water temperatures primarily resulting from dewatering and warm irrigation return flows are undoubtedly affecting the trout fishery of the Smith River. Temperatures above 70°F., which are considered undesirable for trout growth and survival, occur in the river in mid-summer. Water temperatures as high as 80°F. have been recorded (Wipperman 1973).

The annual sediment yield to the Smith River is considered moderately low. However, unnecessary seasonal sediment problems do occur. Severely gullied diversion ditches, early placer mining areas, raw banks along the rechanneled sections of the river, and land erosion resulting from the destruction of the protective vegetative cover by overgrazing, extensive clearcut logging, road building and homesite development are some obvious sources of sediment to the Smith River drainage.

The Smith River is an extremely popular trout stream. It was recently rated by Trout Magazine as 1 of the 100 best trout streams in the United States (including Alaska) (Alexander 1989). A DFWP mail survey of anglers between 1982-1986 showed an average of over 12,000 anglers per year fish the Smith River, with about 2/3 of the use above the mouth of Hound Creek (McFarland 1989).

**STREAM NAME:** Smith River

**STREAM REACH:** #1. From the confluence of the North and South forks to Sheep Creek -- 41 miles

**LOCATION:** Sec. 21A, T9N, R6E to Sec. 14A, T12N, R4E

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish, brook trout, cutthroat trout, burbot

**FISHERY:**

Rainbow trout are the predominant trout species constituting 50-60% of the trout population in this reach of the Smith River. Brown trout make up about 30% of the trout population and brook trout and a few cutthroat make up the remainder. Mountain whitefish are the most numerous game species in this reach and a few burbot are also present. Nongame species found in this reach include white, longnose and mountain suckers, longnose dace and mottled sculpins.

A 1.6-mile section located 1 mile downstream from the confluences of Birch and Newland creeks was electrofished in 1975 and 1976. The estimated population of rainbow, brown and brook trout age 1 and older was 528 trout per mile in 1975 and 672 trout per mile in 1976. An estimate of mountain whitefish in this same section in 1975 revealed 2,381 whitefish per mile (Wipperman 1973, Hill and Wipperman 1977).

The Smith River has been managed as a wild trout fishery since 1974 when all trout stocking was discontinued. Based on the 1982-1986 mail survey of Montana anglers (McFarland 1989), the section of the Smith River from Hound Creek to the headwaters supports an average of about 9,800 angler-days of use per year. A very popular section of river is the 61-mile scenic floating section that starts at the lower end of this reach. Based on an angler survey conducted in 1986, Leathe and Hill (1987) estimated there were 2,630 angler-days of use by floaters in the 61-mile section from Camp Baker to Eden Bridge. Because this survey did not account for bank fishermen or floaters who entered at access points other than Camp Baker, they felt this estimate was probably 25-30% low. Using these values, there would be over 6,000 man-days of angler use in the reach above Sheep Creek. The DFWP maintains two popular fishing access sites and access can be obtained to much of the private land along this reach.

#### **WILDLIFE:**

Mule deer are the most common big game species. White-tailed deer and antelope are found in localized areas. The upper drainage provides important elk habitat. Other big game species include black bear, moose and mountain lion. Upland game birds found adjacent to the river corridor include blue, ruffed and sage grouse and Hungarian partridge. Furbearers frequenting the river corridor include beaver, muskrat, mink, weasel, raccoon and coyote.

Some mallards, blue-winged teal and common mergansers nest along the shoreline and backwaters within this reach. Most of the many species of ducks and geese pass through the area during migration seasons. Some mallards winter along the upper end of this reach.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a riffle area located near the downstream boundary of the reach (Sec. 13C, T12N, R4E). Eight riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 84, 186 and 333 cfs.

The relationship between wetted perimeter and flow for a composite of the 8 riffle cross sections is shown in Figure 3-30. The lower and upper inflection points occur at approximate flows of 50 and 90 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the high quality resident trout fishery in this reach; to provide water for downstream reaches of the Smith River; and to help protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 90 cfs (65,157 A.F./yr.)



# SMITH RIVER (reach 1)

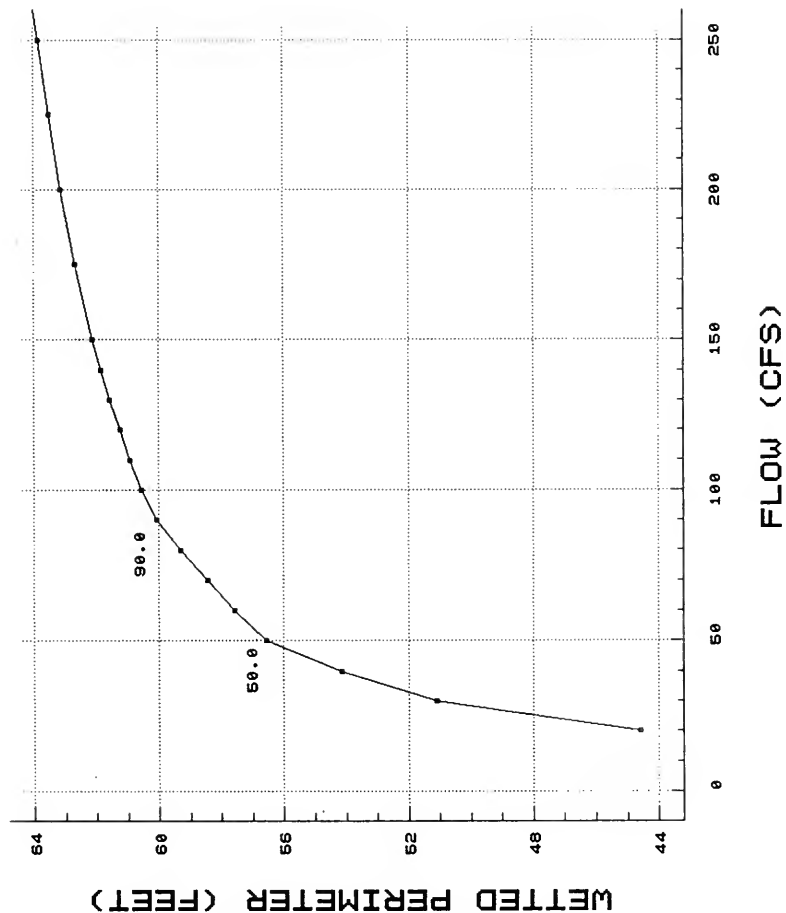


Figure 3-30. The relationship between wetted perimeter and flow for a composite of eight riffle cross sections in Reach 1 of the Smith River.

**STREAM NAME:** Smith River

**STREAM REACH:** #2. From the confluence of Sheep Creek to the confluence of Hound Creek -- 73.6 miles

**LOCATION:** Sec. 14A, T12N, R4E to Sec. 19A, T17N, R5E

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish, brook trout, cutthroat trout, burbot

**FISHERY:**

Rainbow trout are the prevalent trout species in the reach, followed by brown trout. Mountain whitefish are the most numerous game fish. Occasional brook trout, cutthroat trout and burbot are also found. Nongame species include white, longnose and mountain suckers, longnose dace and mottled sculpins.

Population estimates have been conducted most years since 1975 in a 2.04-mile-long electrofishing section near the upper end of this reach. Estimated trout densities for 1984 through 1986 ranged from approximately 1,075 to 1,530 rainbow per mile and 140 to 225 brown trout per mile (Leathe and Hill 1987). No estimates have been made for whitefish.

Population estimates were conducted in 1984 and 1985 on a 3.56-mile-long electrofishing section, located just downstream from the Cascade-Meagher County line. Densities were estimated at 423 and 711 rainbow per mile and 432 and 355 brown trout per mile for 1984 and 1985, respectively (Leathe and Hill 1987).

The Smith River has been managed as a wild trout fishery since 1974 when stocking was discontinued. Based on the 1982-1986 mail survey of Montana anglers (McFarland 1989), the section of the Smith River from Hound Creek to the headwaters supports an average of about 9,800 angler-days of use per year. An angler survey conducted on the 61-mile floating section between Camp Baker and the Eden Bridge in 1986 estimated 2,630 angler-days of use (Leathe and Hill 1987). However, it was felt this estimate was probably 25-30% low because it did not count bank anglers or floaters that entered at access points other than Camp Baker.

#### **WILDLIFE:**

Big game frequent the river corridor along this reach. Mule deer and elk are common along the canyon slopes and meadow areas adjacent to the river. Whitetail deer are localized in one area. Black bear and mountain lion are occasionally observed in the mountainous area adjacent to the river canyon. Upland game birds include blue and ruffed grouse. Furbearers frequenting the river corridor include beaver, muskrat, mink, weasel, raccoon and coyote.

This reach of the Smith River is of minor importance to waterfowl. A few mallards, blue-winged teal, and common mergansers nest along this reach. Most of the many species of ducks and geese pass through the area during migration seasons.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a riffle area located 2 miles upstream from Hound Creek (Sec. 29C, T17N, R3E). Seven riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 142, 171 and 408 cfs.

The relationship between wetted perimeter and flow for a composite of the seven riffle cross sections is shown in Figure 3-31. The lower and upper inflection points occur at approximate flows of about 80 and 150 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the high quality resident trout fishery in this reach; to provide water for the seriously dewatered lower section of the Smith River; and to help protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 150 cfs (108,595 A.F./yr.)

# SMITH RIVER (reach 2)

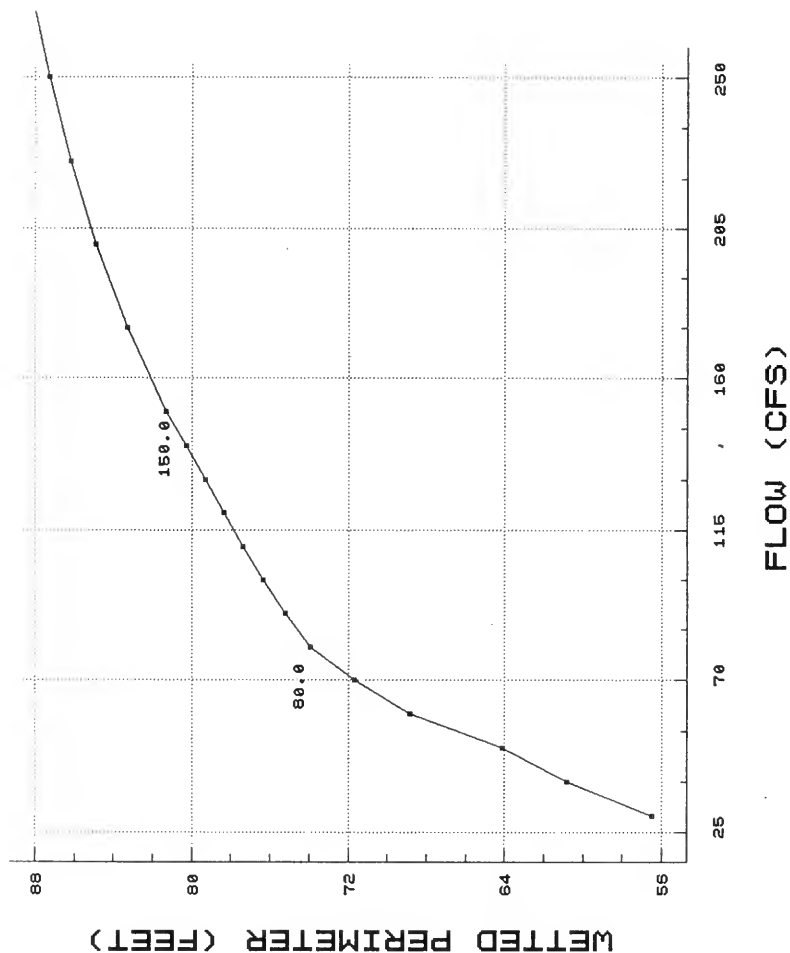


Figure 3-31. The relationship between wetted perimeter and flow for a composite of seven riffle cross sections in Reach 2 of the Smith River.

**STREAM NAME:** Smith River

**STREAM REACH:** #3. From the confluence of Hound Creek to the mouth  
-- 16.5 miles

**LOCATION:** Sec. 19A, T17N, R5E to Sec. 9D, T19N, R2E

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish,  
brook trout, cutthroat trout, burbot

**FISHERY:**

The primary game fish in this reach of the Smith River are rainbow trout, brown trout and whitefish. Occasional brook trout, cutthroat trout, and burbot are also found. Nongame species include white, long nose and mountain suckers, longnose dace and mottled sculpins.

A 13,000-foot section of the lower Smith River near the mouth of Hound Creek was sampled in 1980, but too few trout were captured to make a population estimate. A total of 65 brown trout and 17 rainbow trout, yearlings and older, were captured. It appears that the number of brown trout in proportion to rainbow trout increases in the lower Smith River.

The Smith River has been managed as a wild trout fishery since 1974 when stocking was discontinued. The 1982-1986 mail survey of Montana anglers (McFarland 1989) showed there is an average of about 3,800 angler-days of use annually on the Smith River downstream from Hound Creek. Because habitat in this section of the Smith River is degraded by dewatering and destruction of the riparian zone, it supports a lower quality fishery than the upper 2 reaches. However, more extensive road access along this reach provides for substantial angler use, mostly from bank fishermen.

**WILDLIFE:**

Big game animals found along this reach include white-tailed and mule deer, antelope, elk and an occasional black bear. Upland game birds include ring-necked pheasant, ruffed, blue and sharp-tailed grouse. Furbearers frequenting the river corridor includes beaver, muskrat, mink, weasel, raccoon and coyote. Occasional bald and golden eagles are observed in the area.

This reach of the Smith River is of relatively minor importance to waterfowl. A few mallards and blue-winged teal nest along the lower part of the reach. A few common mergansers are found throughout the reach during the summer months. Most species of ducks and geese pass through the area during migration season.

#### **WETTED PERIMETER:**

No wetted perimeter data were collected in Reach #3. The wetted perimeter data used for Reach #2 were extended downstream to include this reach. Flow requests are based on the same curve presented for Reach #2 (Figure 3-31). Because of poorer habitat conditions, the trout fishery in this Reach is not as high quality as that in Reaches #1 and #2. Therefore, the lower inflection point flow derived for Reach #2 is being requested for Reach #3.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout fishery, to prevent further dewatering of the lower end of this reach and to help protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 80 cfs (57,917 A.F./yr.)

The requested flow is the low inflection point flow determined for Reach #2.

**STREAM NAME:** South Fork Smith River

**STREAM REACH:** From the headwaters to the mouth -- 42 miles

**LOCATION:** Sec. 6D, T7N, R8E to Sec. 21A, T9N, R6E

**DESCRIPTION OF STREAM REACH:**

South Fork Smith River is located in Meagher County in central Montana. The stream originates south of the Crazy Mountains, flows west for a short distance then turns north and flows northwest to join the North Fork of the Smith River. The North and South Forks join near White Sulphur Springs to form the Smith River. The elevation of the stream ranges from 6,120 feet at the headwaters to 4,900 feet at the mouth.

From the headwaters to Highway 89, the stream parallels Highway 294, then turns northwest and parallels Highway 89 to its junction with Highway 12. The South Fork Smith River is a low gradient stream which meanders through open sage brush country in its upper reach and through moist sedge meadows in the lower half of the drainage. The entire reach is on private land. Major tributaries to South Fork Smith River are Cottonwood Creek and Hot Springs Creek.

Channel substrate is predominantly gravel and silt. Riparian vegetation is largely willows and prairie grasses in the upper reaches changing to grasses and sedges in the lower half of the drainage. Land use includes recreation, livestock grazing, hay and grain production.

**GAME FISH PRESENT:** Brown trout, brook trout

**FISHERY:**

A statewide mail survey showed the South Fork Smith River supported up to 1,000 angler-days of use per year for the period of time between 1982-86 (McFarland 1989). Brook trout are by far the most abundant game fish found throughout this stream; some brown trout occur in the lower portions of the drainage. Two sections of the South Fork were electrofished in June of 1970 (Wipperman 1973) during the Smith River Inventory and Planning Investigation. The lower section was located approximately 4.5 miles upstream from its confluence with the North Fork near the mouth of Hot Springs Creek. The brook trout population in this section was 449 trout per 1,000

feet of stream (Table 3-37). The upper section was located near the junction of Highway 89 and Highway 294, approximately 29 miles upstream from the confluence with the North Fork. Population estimates in this section were 57 trout per 1,000 feet of stream (Table 3-38).

Table 3-37. Estimated trout populations in a 2,600-foot lower section of South Fork Smith River sampled in the summer of 1970.

Species	Length group (in.)	Number per 2,600 ft.
Brook trout	4.3-11.1	1,161 ( $\pm$ 92)
Brown trout	5.1-13.6	7 ( $\pm$ 4)

Table 3-38. Estimated trout population in an 11,630-foot upper section of South Fork Smith River sampled in the summer of 1970.

Species	Length group (in.)	Number per 11,630 ft.
Brook trout	3.9-14.3	667 ( $\pm$ 170)

#### WILDLIFE:

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include sage, ruffed and blue grouse. Occasional waterfowl use occurs on the South Fork Smith River and substantial numbers of sandhill cranes and curlews are seasonally present. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present. The drainage has recently been identified as an important migratory corridor for golden eagles

#### WETTED PERIMETER:

Cross-sectional data were collected on a 1,000-foot section of South Fork Smith River (Sec. 21D, T9N, R6E) 1 mile from its confluence with the Smith River. Five cross sections were established. The WETP program was calibrated to field data collected at flows of 2.5, 10.7, 28.2 and 34.2 cfs.



The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-32. An upper inflection point occurs at an approximate flow of 7 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 7.0 cfs (5,068 A.F./yr.)

# SOUTH FORK SMITH RIVER

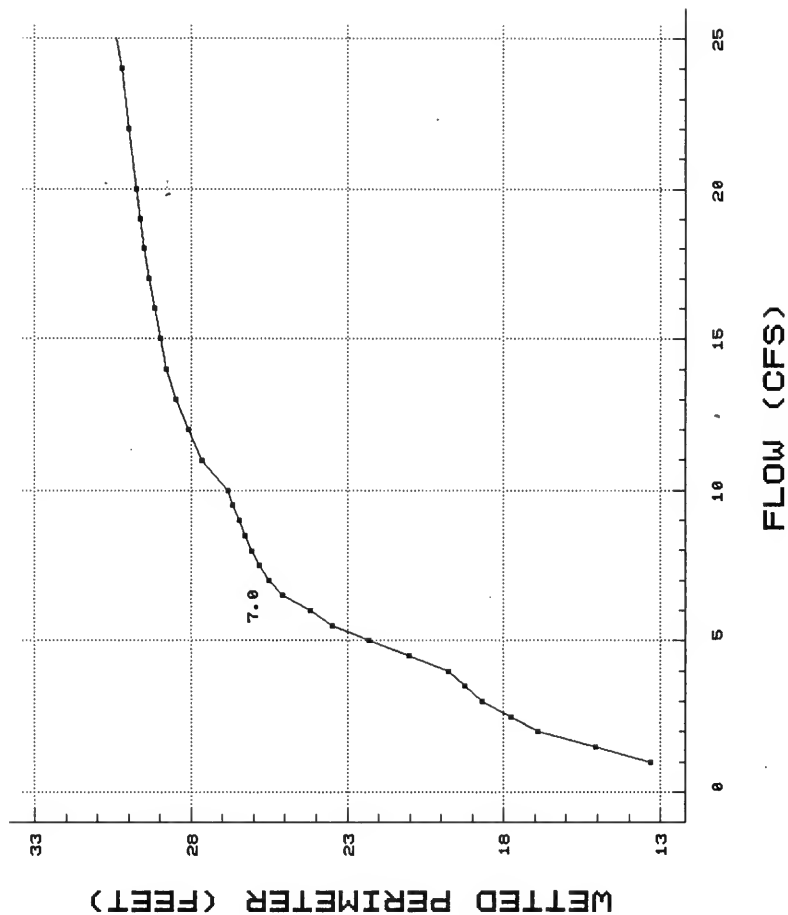


Figure 3-32. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in the South Fork of the Smith River.

**STREAM NAME:** North Fork Smith River

**STREAM REACH:** From the headwaters to the mouth -- 42.7 miles

**LOCATION:** Sec. 29D, T12N, R9E to Sec. 21A, T9N, R6E

**DESCRIPTION OF STREAM REACH:**

North Fork Smith River is located in Meagher County in central Montana. The stream originates in the Little Belt Mountains on the south side of Lost Fork Ridge. The elevation of the stream ranges from 7,965 feet at the headwaters to 4,900 feet at the mouth.

From its origin the stream flows south through a narrow coniferous mountain valley for approximately 5 miles to the U.S. Forest Service boundary, then turns westward and flows through open sagebrush foothills in a southwesterly direction. The section of stream within the National Forest is a high gradient mountain stream with a boulder-rubble substrate. Soon after leaving the National Forest, the gradient decreases and the stream begins to meander through aspen-willow groves until it enters Smith River Reservoir.

Smith River Reservoir was formed in 1936 by impounding the river at a point 22.8 miles upstream from the mouth. This reservoir covers 325 acres and contains 11,600 acre-feet of water at full pool. It was constructed for irrigation and recreation.

From Smith River Reservoir to its confluence with Fourmile Creek, the North Fork meanders through a more open sagebrush range land with mostly willow and some aspen as riparian vegetation. From Fourmile Creek to the confluence with the Smith River, the bottom land widens and the stream meanders through extensive hay fields. Once out of the forest, the stream substrate changes to cobble-gravel and then to gravel-sand-silt in the lower reaches. Fine sediment accumulates in low gradient areas and where beaver activity occurs.

Only the upper 5 or 6 miles is on public land, the rest of the reach is on private land. The major tributaries to North Fork Smith River are Spring, Willow, Trout, Studhorse, Geis, Sawmill, and Dry creeks.

Major agricultural uses are livestock grazing and hay production; grain production is limited. Other uses include recreation, logging and mining.

The USGS operated a gauge on the North Fork Smith River 28.4 miles upstream from its confluence with the Smith River, and immediately upstream from Smith River Reservoir. The mean annual flow for the 11-year period of record (1923-31 and 1934-36) was 20.7 cfs.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

A statewide mail survey indicates that the North Fork Smith River supported up to 600 angler-days of use per year for the period of time 1982-86 (McFarland 1989). A 2,600-foot section of the North Fork Smith River was electrofished in the summer of 1983 (Hill and Wipperman 1983). The sample section was just west of White Sulphur Springs, approximately 5 miles upstream from the mouth. The estimate showed a standing crop of 176 trout per 1,000 feet of stream (Table 3-39). Smith River Reservoir is stocked annually with rainbow trout, contains a naturally reproducing burbot population and supports an average of 4,188 angler-days of use a year. A new strain of rainbow has been planted in the reservoir in recent years in hopes of establishing a wild trout population that reproduces naturally by spawning in the North Fork above the reservoir.

Table 3-39. Estimated trout populations in 2,600 feet of the North Fork Smith River sampled in the summer of 1983. (80% confidence intervals are in parentheses.)

Species	Length group (in.)	Number per 2,600 ft.
Brown trout	6.1-21.3	434 ( $\pm$ 79)
Brook trout	8.0-13.0	23 ( $\pm$ 7)
Rainbow trout	6.0-12.9	9*

\* Actual numbers caught -- sample size too small to make an estimate.

**WILDLIFE:**

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Occasional waterfowl use occurs. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote.

Various songbirds, raptors, and other small mammals are present.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on a 1,000-foot section of North Fork Smith River (Sec. 5D, T9N, R7E) about 1.5 miles upstream above the confluence with the Smith River. Six cross sections were established. The WETP program was calibrated to field data collected at flows of 2.4, 38.1 and 106.1 cfs.

The relationship between wetted perimeter and flow for a composite of the 6 riffle cross sections is shown in Figure 3-33. An upper inflection point occurs at an approximate flow of 9 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population; to provide spawning and rearing habitat for the Smith River Reservoir rainbow trout; and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 9 cfs (6,516 A.F./yr.)

# NORTH FORK SMITH RIVER

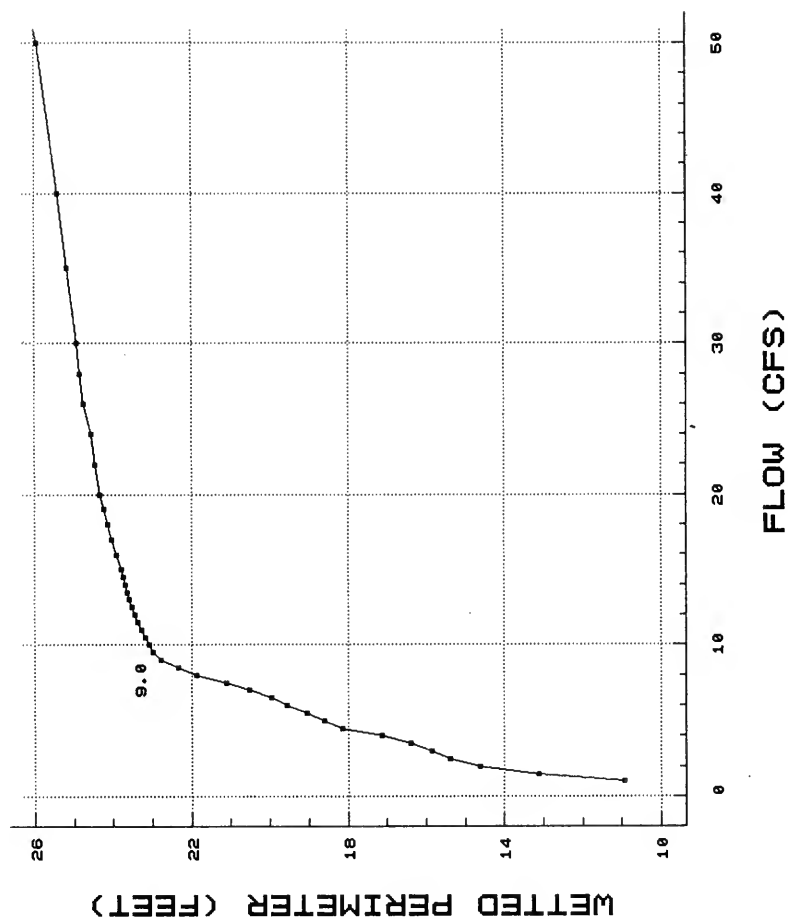


Figure 3-33. The relationship between wetted perimeter and flow for a composite of six riffle cross sections in the North Fork of the Smith River.

**STREAM NAME:** Newlan Creek

**STREAM REACH:** From the headwaters to the mouth -- 24.2 miles

**LOCATION:** Sec. 7D, T11N, R8E to Sec. 36B, T10N, R5E

**DESCRIPTION OF STREAM REACH:**

Newlan Creek is located in Meagher County in central Montana. The stream originates in the Little Belt Mountains on the west slope of Smoky Mountain. The elevation of the stream ranges from 6,400 feet at the headwaters to 3,995 feet at the mouth.

From its origin, the stream flows west along a Forest Service road for 5 miles, turns southwest, paralleling state Highway 89 for 5.5 miles, and then follows a county road for the remainder of its course to the Smith River. Approximately 7 miles of the upper reach is on U.S. Forest Service land and the lower reach is entirely on private land. Major tributaries to Newlan Creek are Charcoal Gulch and Pistol Creek.

The Holstrom ditch (Sheep Creek diversion) enters the stream on the right bank 19.5 miles upstream from the mouth near Highway 89. The operation of the Holstrom ditch depends on its state of repair, which varies from year to year.

Newlan Creek Reservoir was formed in 1976 by impounding the creek at a point 9.2 miles upstream from the mouth. This reservoir covers 327 acres and contains 14,030 acre-feet of water at full pool. It was constructed for irrigation and recreation.

The reach of Newland Creek above the reservoir is a fairly low gradient stream which flows through numerous mountain meadows in a large valley. Beaver activity is extensive above Newlan Creek Reservoir. The 9.2-mile reach below the reservoir to the confluence with the Smith River, flows through open sagebrush benchland. Most of the mid-summer flows in this lower reach are diverted for irrigation. Land use includes recreation, logging, livestock grazing, hay and grain production. Some old mining activity is evident in the headwaters area.

The USGS operated a gauge 8.8 miles upstream from the mouth of Newlan Creek from 1950 to 1957. The mean annual flow for this 7-year period of record was 9.53 cfs. Mean monthly flows for the 1953 water year ranged from 0.84 cfs in February to 22.4 cfs in June.

**GAME FISH PRESENT:** Cutthroat trout, rainbow trout, brook trout

**FISHERY:**

Two sections of Newlan Creek were electrofished in the summer of 1971 (Wipperman 1973) for the Smith River Inventory and Planning Investigation. Section 1 is in the lower reach approximately 3 miles upstream from the confluence with the Smith River. Section 2 is in the upper reach in the vicinity of the outlet of the Holstrom ditch. Electrofishing data are summarized in Tables 3-40 and 3-41.

Newlan Creek Reservoir is stocked annually with cutthroat trout and also supports a significant population of rainbow trout that appear to spawn in the creek upstream from the reservoir. Newlan Creek Reservoir is one of the most popular fishing lakes in central Montana and it currently supports approximately 15,500 angler-days of use per year (McFarland 1989).

Table 3-40. Summary of electrofishing catch for section 1, a 395-foot section of Newlan Creek sampled in the summer of 1971.

<u>Species</u>	<u>Number Captured</u>	<u>Length Range (in.)</u>
Rainbow trout	1	9.4
Brook trout	72	2.8-11.8

Table 3-41. Summary of electrofishing catch for section 2, a 460-foot section of Newlan Creek sampled in the summer of 1971.

<u>Species</u>	<u>Number Captured</u>	<u>Length Range (in.)</u>
Rainbow trout	4	3.8-7.7
Brook trout	23	2.1-10.1



#### **WILDLIFE:**

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Occasional waterfowl use occurs on Newlan Creek. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on a 291-foot section of Newlan Creek (Sec. 29A, T11N, R7E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 2.2 and 7.2 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-34. Lower and upper inflection points occur at approximate flows of 2.4 and 3.8 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population in the creek; to maintain spawning habitat for the established rainbow fishery in Newlan Creek Reservoir; and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 3.8 cfs (2,751 A.F./yr.)

# NEWLAN CREEK

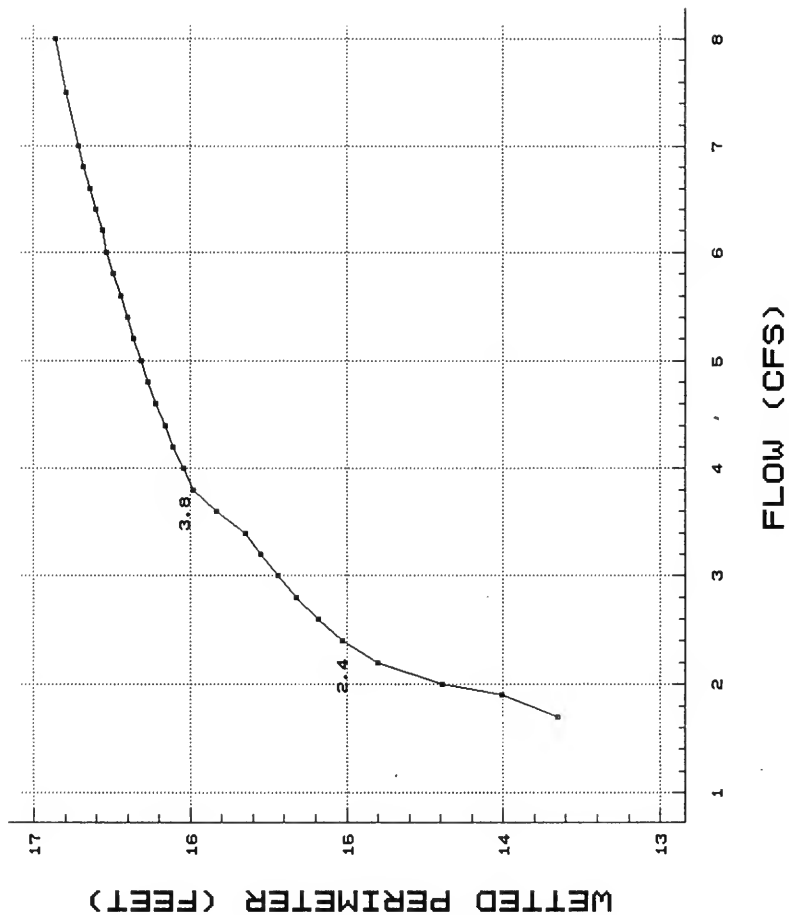


Figure 3-34. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Newlan Creek.

**STREAM NAME:** Big Birch Creek

**STREAM REACH:** From the headwaters to the mouth -- 15.8 miles

**LOCATION:** Sec. 22A, T8N, R4E to Sec. 36B, T10N, R5E

**DESCRIPTION OF STREAM REACH:**

Big Birch Creek is located in Meagher County in central Montana. The stream originates on the north end of the Big Belt Mountains. The elevation of the stream ranges from 8,020 feet at the headwaters to 3,997 feet at the mouth.

A series of small mountain lakes form the headwaters of Big Birch Creek. The stream flows northeasterly through a narrow coniferous mountain canyon before entering the foothills where it flows through a willow-choked valley to its confluence with the Smith River. The substrate consists of boulders and rubble in the upper reaches of the stream to rubble and gravel at lower elevations. A thin layer of silt covers the stream bed throughout the agriculturally developed areas. Some placer mining activity is evident within the lower mountain canyon area. The upper 5 miles is on U.S. Forest Service land and the remainder is on private lands.

Extensive cattle ranching occupies most of the watershed and most of the mid-summer flow is diverted for irrigation. Some cultivated crops are grown on the benchlands within the drainage. Major tributaries include Gipsy and Little Birch creeks.

**GAME FISH PRESENT:** Cutthroat trout, rainbow trout, brook trout

**FISHERY:**

Big Birch Creek has supported up to 450-angler days of use per year (McFarland 1989). Two sections of Big Birch Creek were electrofished in the summer of 1971 (Wipperman 1973) during the Smith River Inventory and Planning Investigation. Section 1 is in the lower reach approximately 1/2 mile upstream from the confluence of Little Birch Creek. Section 2 is in the upper reach 1/8 mile above the confluence with Gipsy Creek. The lower section contained high numbers of brook trout and fewer rainbow trout (Table 3-42). The upper section was dominated by brook trout with a few cutthroat trout present (Table 3-43).

Table 3-42. Summary of electrofishing catch for section 1, a 300-foot section of Big Birch Creek sampled in the summer of 1971.

Species	Number Captured	Length Range (in.)
Rainbow trout	24	2.3-11.9
Brook trout	79	3.3-11.7

Table 3-43. Summary of electrofishing catch for section 2, a 400-foot section of Big Birch Creek sampled in the summer of 1971.

Species	Number Captured	Length Range (in.)
Cutthroat trout	4	5.3-8.0
Brook trout	31	2.3-7.6

#### WILDLIFE:

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, mountain lion, and moose. Game birds utilizing the drainage include ruffed and blue grouse. Occasional waterfowl use occurs on Big Birch Creek. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 541-foot section of Big Birch Creek 300 yards upstream from the confluence with the Smith River (Sec. 35D, T10N, R5E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 9.8, 16.8 and 41.1 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-35. An upper inflection point occurs at an approximate flow of 11 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population in the creek and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 11 cfs (7,964 A.F./yr.)

# BIG BIRCH CREEK

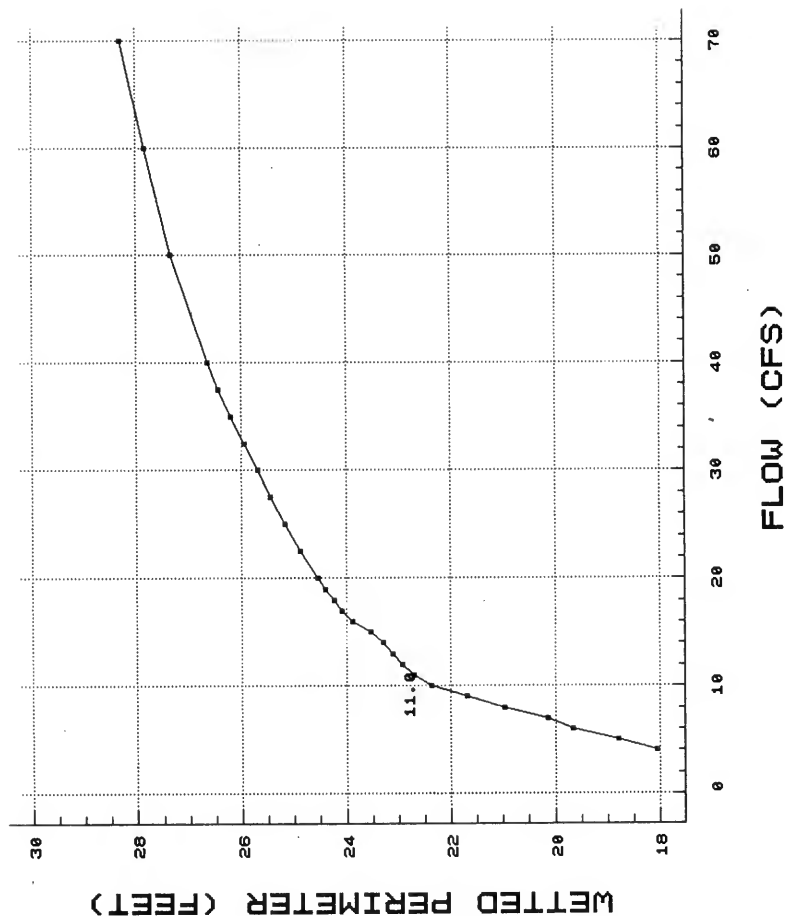


Figure 3-35. The relationship between wetted perimeter and flow for a composite of five rifle cross sections in Big Birch Creek.

**STREAM NAME:** Sheep Creek

**STREAM REACH:** From the headwaters to the mouth -- 41.9 miles

**LOCATION:** Sec. 3A, T12N, R8E to Sec. 14A, T12N, R4E

**DESCRIPTION OF STREAM REACH:**

Sheep Creek is located in Meagher County in central Montana. The stream originates in the Little Belt Mountains near Kings Hill Pass. The stream flows westerly through a mountain valley containing numerous meadows to its confluence with the Smith River. It is paralleled by Highway 89 for about 17 miles (40% of its length).

Major tributaries to Sheep Creek are: Cabin, Calf, Moose, Little Sheep, Jumping, Lamb, and Deadman creeks. The elevation of the stream ranges from 7,197 feet at the headwaters to 4,377 feet at the mouth. The mean gradient of the stream is about 1.7%.

The upper third of the stream flows through U.S. Forest Service (USFS) land, the mid-section is checkerboard in ownership (U.S. Forest Service and private land) and the lower 7.5 miles is totally on private land. The Forest Service maintains two designated recreation sites, including camping facilities along the stream. The USFS installed log step dams in the vicinity of Moose Creek in 1961 to improve trout habitat by providing scour holes and additional cover.

Substrate in the stream consists largely of boulders, rubble and gravel. Finer material accumulates in the lower gradient areas. Willows dominate the riparian zone, interspersed with conifers and aspen in the timbered sections and grasses in the more open meadows. Land uses include recreation, logging, mining, grazing, and hay production. There is ample public access along the stream except for the lower 8 miles of private land.

The USGS operated a gauge on Sheep Creek 28.3 miles upstream from the confluence with the Smith River. The mean annual flow for the 31-year period of record (1941-72) was 31.9 cfs.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout, cutthroat trout, mountain whitefish

## FISHERY:

Sheep Creek has long been considered an excellent fishery. With good access to USFS land along a major state highway, fishermen use has been high at times. Heavy fishing pressure in the early 1950s prompted the DFWP to begin planting Sheep Creek with hatchery fish. This practice has continued to the present but is now limited to the upper reach of the stream in the vicinity of Jumping Creek. With this minor exception, Sheep Creek is predominantly managed as a wild trout fishery.

A 1,016-foot section, located 1.3 miles upstream from the confluence of Moose Creek, was sampled in the summer of 1979 (Table 3-44). The population of rainbow trout in the section was estimated by Lere (1982) using a mark-recapture method. The survey also found brook trout and lesser numbers of brown trout in this section, but numbers were too low to estimate a standing crop. This section of creek has a substrate of mostly boulders, rubble and lesser amounts of gravel (20%). Willows dominate the riparian zone.

Table 3-44. Estimated trout population in 1,016 feet of Sheep Creek sampled in 1979. (80% confidence intervals in parentheses.)

Species	Length group (in.)	Number per 1,016 ft.
Rainbow trout	3.9-13.4	945 ( $\pm$ 97)

## WILDLIFE:

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Occasional waterfowl use occurs on Sheep Creek. Other important wildlife species include mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present.

## WETTED PERIMETER:

Cross-sectional data were collected on a 400-foot section of Sheep Creek (Sec. 13A, T12N, R4E) 1 mile upstream from the confluence with the Smith River. Data were collected on six riffle cross sections. The WETP program was calibrated to field data collected at flows of 20.9, 59.1 and 157.4 cfs.



The relationship between wetted perimeter and flow for a composite of the 6 riffle cross sections is shown in Figure 3-36. Lower and upper inflection points occur at approximate flows of 20 and 35 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population on this popular fishing stream; to continue to provide much needed water to the Smith River; and to assist in maintenance of habitat for those wildlife species which depend upon the stream and its riparian zone for food, water, and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 35 cfs (25,339 A.F./yr.)

# SHEEP CREEK

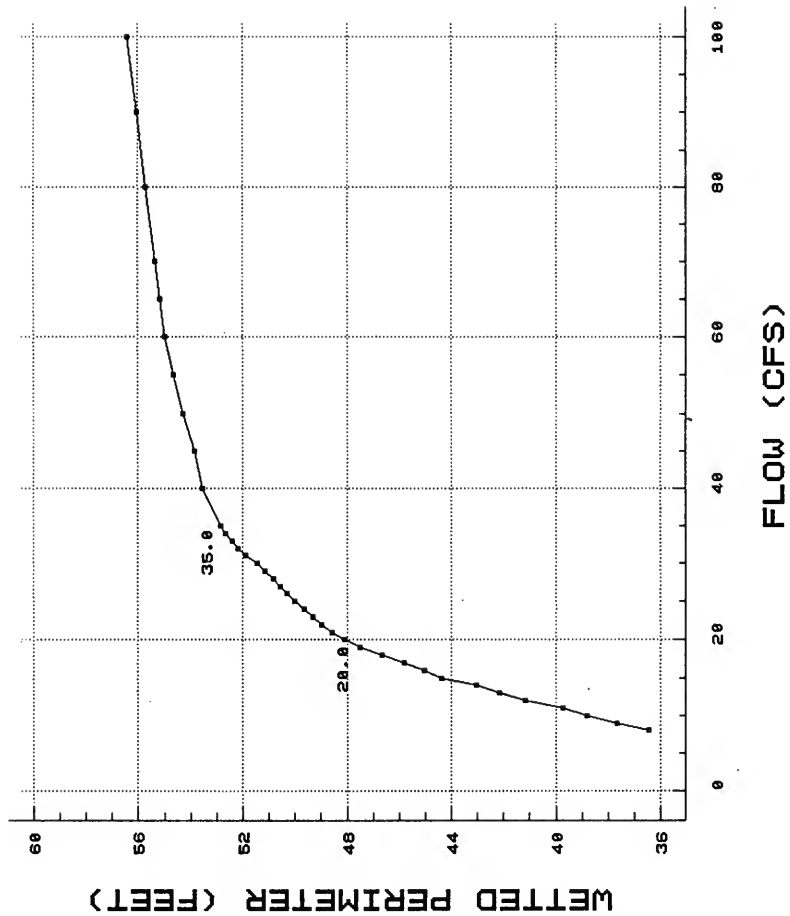


Figure 3-36. The relationship between wetted perimeter and flow for a composite of six riffle cross sections in Sheep Creek.

**STREAM NAME:** Eagle Creek

**STREAM REACH:** From the headwaters to the mouth -- 14.6 miles

**LOCATION:** Sec 11A, T12N, R4E to Sec 9A, T13N, R6E

**DESCRIPTION OF STREAM REACH:**

Eagle Creek is located in Meagher County in central Montana. The stream originates in the Little Belt Mountains at McKay Spring on the south side of Williams Mountain. The elevation of the stream ranges from 6,990 feet at the headwaters to 4,350 feet at the mouth.

The stream flows southwest to its confluence with the Smith River. The upper 6 miles is a high gradient mountain stream which flows through a dense coniferous forest on U.S. Forest Service land. The lower 8.5 miles is a lower gradient stream which flows through more open country. This stretch is entirely on private land. Major tributaries to Eagle Creek are North Fork Eagle, East Fork Eagle, and Park creeks.

Substrate in the stream consists largely of boulders, rubble and gravel. Finer material predominates in the lower gradient areas and where beaver occur. Land use includes recreation, logging, livestock grazing and crop production.

**GAME FISH PRESENT:** Cutthroat trout, rainbow trout, brook trout

**FISHERY:**

A 400-foot section of Eagle Creek was electrofished in the summer of 1971 (Wipperman 1973) during the Smith River Inventory and Planning Investigation. The survey area contained mostly rainbow trout with lesser numbers of cutthroat and brook trout (Table 3-45.)

Table 3-45. Summary of electrofishing catch for 400 feet of Eagle Creek sampled in the summer of 1971.

Species	Number Captured	Length Range (in.)
Rainbow trout	26	3.4-12.7
Cutthroat trout	4	4.2-8.0
Brook trout	3	5.5-9.3

#### **WILDLIFE:**

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Occasional waterfowl use occurs on Eagle Creek. Other important wildlife species include mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are also present.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 130-foot section of Eagle Creek (Sec. 1D, T12N, R4E) about 1.5 miles upstream from the confluence with the Smith River. Data were collected on five riffle cross sections. The WETP program was calibrated to field data collected at flows of 1.5, 5.2 and 8.8 cfs.

The relationship between wetted perimeter and flow for a composite of the 5 riffle cross sections is shown in Figure 3-37. An upper inflection point occurs at an approximate flow of 2.5 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population and to help protect the habitat for those wildlife species which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 2.5 cfs (1,810 A.F./yr.)

# EAGLE CREEK

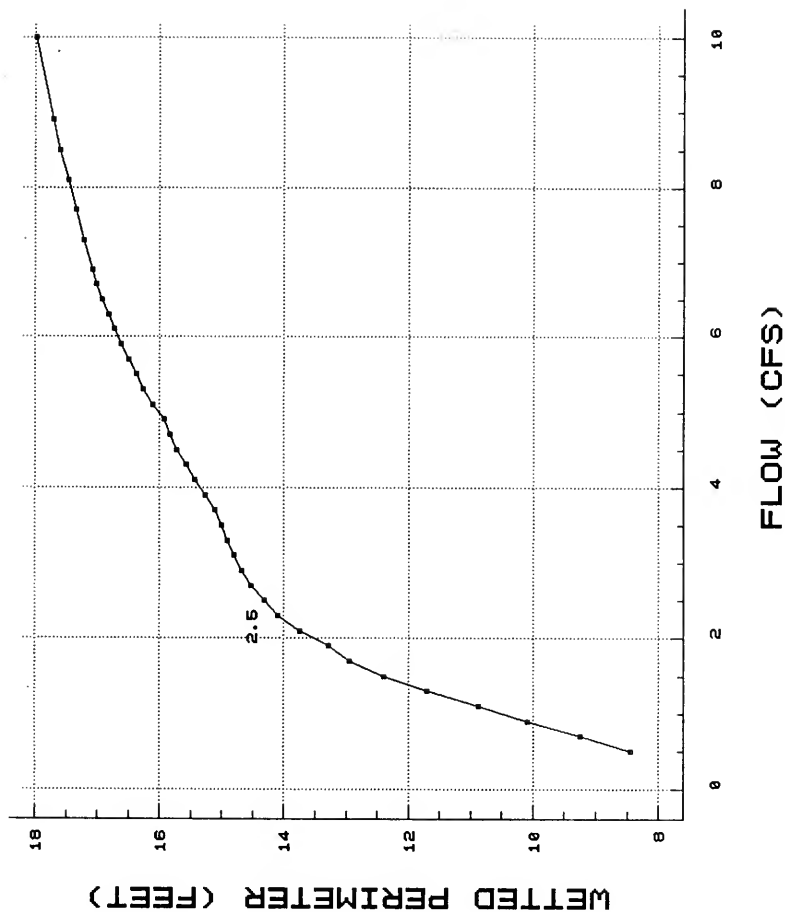


Figure 3-37. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Eagle Creek.

**STREAM NAME:** Rock Creek

**STREAM REACH:** From the headwaters to the mouth -- 24.8 miles

**LOCATION:** Sec. 27B, T13N, R1E to Sec. 19D, T13N, R4E

**DESCRIPTION OF STREAM REACH:**

Rock Creek is located in Meagher County in central Montana. The stream originates in the Big Belt Mountains on the north end of Jim Ball Basin. The elevation of the stream ranges from 6,120 feet at the headwaters to 3,240 feet at the mouth.

From its origin, the stream flows east to its confluence with the Smith River. The upper reach is fairly low gradient and flows through extensive parklands. The lower 3 miles of creek flows through a steep canyon. Rock Creek runs entirely through private land. Major tributaries to Rock Creek are French, Onion, North Fork Rock, Indian and Freeman creeks.

Stream substrate consists largely of rubble and cobble changing to cobble and gravel in the lower section. Current land use includes recreation, logging, livestock grazing and hay production.

**GAME FISH PRESENT:** Cutthroat trout, rainbow trout, brook trout, brown trout

**FISHERY:**

A 5,600-foot section of Rock Creek near Lingshire was electrofished in the summer of 1971 (Wiperman 1973) during the Smith River Inventory and Planning Investigation. Rainbow trout were the dominant species and lesser numbers of brown and brook trout were found (Table 3-46). Total trout numbers were estimated to be 167 per 1,000 feet.

Table 3-46. Estimated trout population in 5,600 feet of Rock Creek sampled in the summer of 1971. (95% confidence intervals in parentheses.)

Species	Length group (in.)	Number per 5,600 ft.
Rainbow trout	2.6 - 12.5	849 ( $\pm$ 244)
Brown trout	5.2 - 21.5	67 ( $\pm$ 32)
Brook trout	4.9 - 10.2	20 ( $\pm$ 15)

Two additional sections of Rock Creek upstream from the section near Lingshire were also sampled by electrofishing in 1971 (Wipperman 1973). These headwater sections contained rainbow and cutthroat but no brown or brook trout (Tables 3-47 and 3-48).

Table 3-47. Summary of electrofishing catch for 395 feet of Rock Creek 9.6 miles upstream from Lingshire sampled in the summer of 1971.

Species	Number Captured	Length Range (in.)
Rainbow trout	31	2.2-10.1
Cutthroat trout	4	4.3-9.0

Table 3-48. Summary of electrofishing catch for 460 feet of Rock Creek 15.4 miles upstream from Lingshire sampled in the summer of 1971.

Species	Number Captured	Length Range (in.)
Cutthroat trout	18	3.8-8.9

#### WILDLIFE:

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Occasional waterfowl use occurs on Rock Creek. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are also present.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on a 1,000-foot section of Rock Creek (Sec. 32A, T13N, R3E) near Lingshire. Five cross sections were established. The WETP program was calibrated to field data collected at flows of 5.6, 13.2 and 34.0 cfs.

The relationship between wetted perimeter and flow for a composite of the 6 riffle cross sections is shown in Figure 3-38. An upper inflection point occurs at an approximate flow of 11 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population and to help protect the habitat for those wildlife species depending upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 11 cfs (7,964 A.F./yr.)



# ROCK CREEK

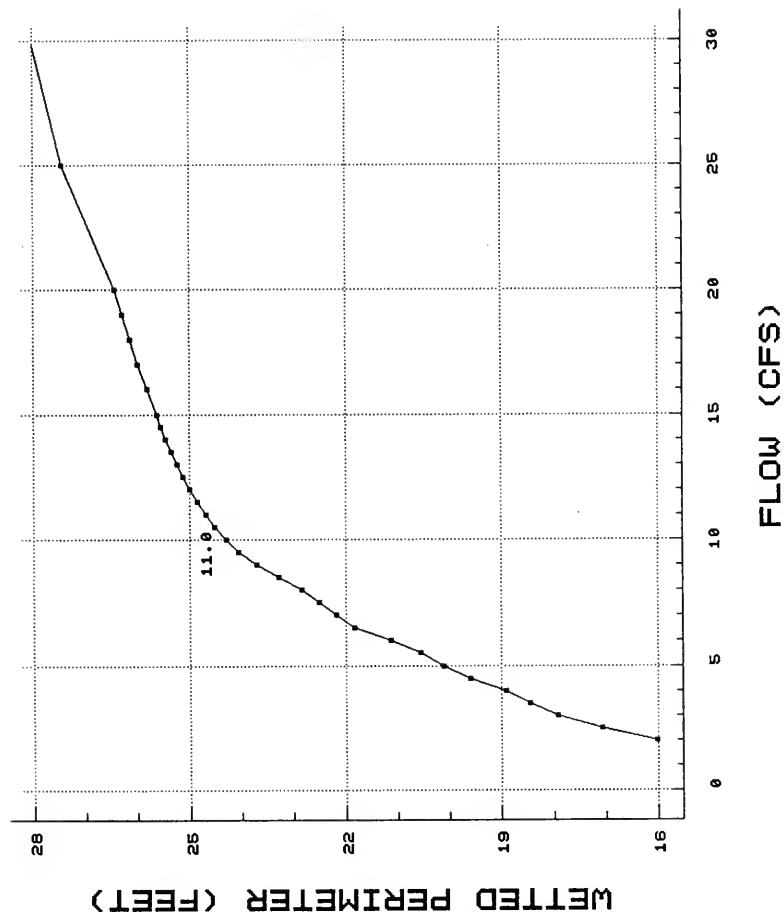


Figure 3-38. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Rock Creek.

**STREAM NAME:** Tenderfoot Creek

**STREAM REACH:** From the headwaters to the mouth -- 27.0 miles

**LOCATION:** Sec. 4C, T13N, R7E to Sec. 25D, T14N, R3E

**DESCRIPTION OF STREAM REACH:**

Tenderfoot Creek originates at Onion Park in the Little Belt Mountains and flows east to its confluence with the Smith River. It is a major Smith River tributary draining approximately 110 square miles. Tributaries to Tenderfoot Creek include: Bear, South Fork Tenderfoot, Ditch, Bolsinger, Rugby, Fisher and Lobley creeks.

The upper 17.5 miles of Tenderfoot Creek flow through mountainous timbered terrain intermixed with meadows. Surrounding vegetation consists of a mature coniferous forest. The 1.5 miles between the confluence with the South Fork Tenderfoot Creek and Bear Creek is a deep canyon with high limestone walls similar to those of the Smith River. This section includes a scenic 25-foot waterfall. The 8.0 miles of stream from Bear Creek to the confluence with the Smith River is less confined, with decreasing gradient and increasing stream width, as it flows through more open meadow terrain. Substrate in the stream consists largely of boulders and rubble in the upper reaches changing to cobble and gravel nearer the mouth.

The upper 17.8 miles of stream flow through U.S. Forest Service (USFS) property. The land below the confluence with the South Fork is checkerboard in ownership (USFS and private land). Approximately 4 to 5 miles including the mouth of Tenderfoot Creek is privately owned.

Land use includes logging in the upper reach of the drainage and some grazing and hay production in the lower reaches. Limited gold, silver and copper mining has historically taken place in the drainage. Recreation in the form of hunting, fishing and hiking is a major use of this area. The Tenderfoot drainage has considerable aesthetic qualities and is currently under consideration as a wilderness area. Vehicle access to the creek is limited to an unmaintained secondary USFS road which parallels the creek for about 5 miles from the South Fork Tenderfoot to Lions Gulch.

**GAME FISH PRESENT:** Rainbow trout, cutthroat trout, brook trout, brown trout

**FISHERY:**

Although access is somewhat limited, Tenderfoot Creek has long been a popular fishery on a statewide basis. It provides up to 400 angler-days of use per year (McFarland 1989). A 500-foot section just upstream from the confluence with the South Fork Tenderfoot was sampled on August 29, 1988. Electro-fishing results found rainbow, cutthroat and rainbow x cutthroat hybrids. Large numbers of sculpin were also seen. Results of this sampling are summarized in Table 3-49. This section of creek has a substrate of boulders and cobble and a moderately dense cover of riparian vegetation comprised mostly of dogwood. Stream width at the time of survey was 15 feet and pool development was moderate.

Tenderfoot Creek has been proposed for Wild and Scenic classification, and, in conjunction with that, the USFS has initiated a study of the fishery. In mid-November of 1988, redd counts for brown trout were made. Between the mouth of Tenderfoot Creek and the falls, 208 brown trout redds where counted (Len Walsh, U.S. Forest Service, personal communication to R-4 Fisheries personnel). Further field data on spawning in conjunction with this study will be collected in the spring of 1989.

Table 3-49. Summary of electrofishing catch in 500 feet of Tenderfoot Creek sampled in August 29, 1988.

<u>Species</u>	<u>Number Captured</u>	<u>Length Range (in.)</u>
Rainbow trout	158	3.3-12.4
Cutthroat trout	1	9.9
Hybrid	5	4.9-9.2

A population estimate of 172 rainbows per 500 feet of stream was made using a two-pass method (Leathe 1983) (Table 3-50). Populations of cutthroat and hybrids were too low to estimate separately.

Table 3-50. Estimated rainbow trout population in 500 feet of Tenderfoot Creek sampled August 29, 1988. (80% confidence intervals in parentheses.)

Species	Length group (in.)	Number per 500 ft.
Rainbow trout	3.3 - 12.4	172 ( $\pm$ 9)

#### WILDLIFE:

Big game species using the area include mule and white-tailed deer, elk, black bear, and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Little waterfowl use occurs on Tenderfoot Creek. Other important wildlife species include mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are also present.

#### WETTED PERIMETER:

Cross-sectional data were collected on a 300-foot section of Tenderfoot Creek (Sec. 30 A,B,C, T14N, R5E) 1/2 mile above its confluence with the South Fork Tenderfoot Creek. Six riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 10.8, 57.7 and 104.9 cfs.

The relationship between wetted perimeter and flow for a composite of the 6 riffle cross sections is shown in Figure 3-39. Lower and upper inflection points occur at approximate flows of 9 and 15 cfs, respectively.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations in this popular fishing stream; to continue to provide much needed water to the Smith River; and to assist in maintenance of habitat for those wildlife species depending upon the stream and its riparian zone for food, water, and shelter.

#### FLOW REQUEST:

January 1-December 31 -- 15 cfs (10,859 A.F./yr.)

# TENDERFOOT CREEK

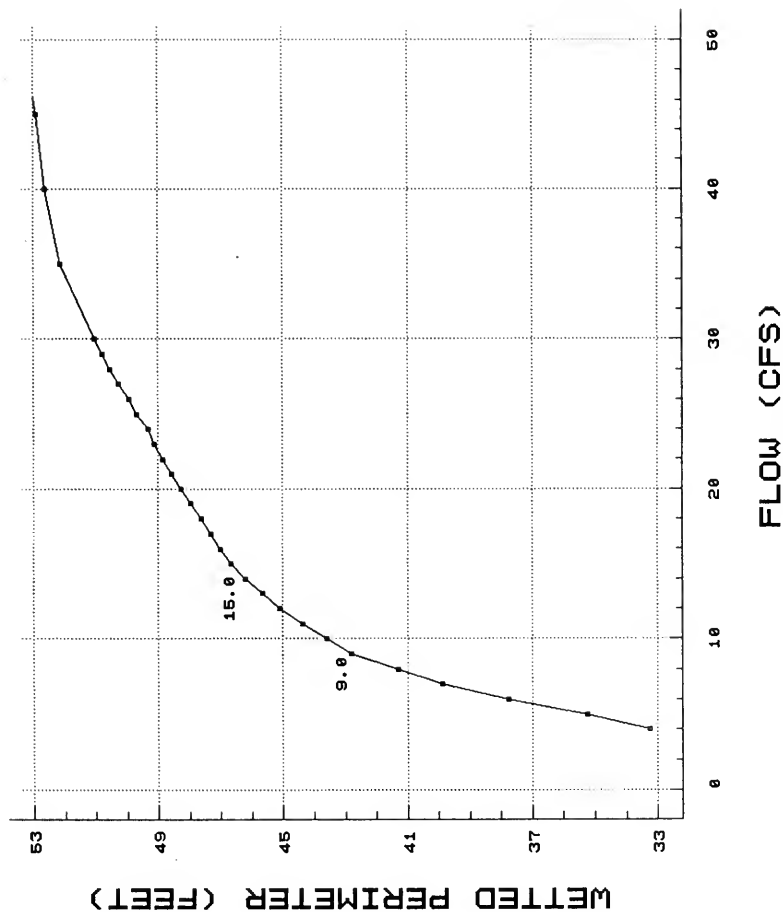


Figure 3-39. The relationship between wetted perimeter and flow for a composite of six riffle cross sections in Tenderfoot Creek.

**STREAM NAME:** North Fork Deep Creek

**STREAM REACH:** Headwaters to rock cascades

**LOCATION:** Sec. 21, T15N, R5E to Sec. 19, T15N, R5E

**DESCRIPTION OF STREAM REACH:**

The North Fork of Deep Creek heads near Monument Ridge roughly 11 air miles southwest of the town of Monarch in the Little Belt Mountains. The stream flows westerly for about 3 miles where it joins the South Fork to form Deep Creek. Deep Creek is a tributary to the Smith River. The entire reach of the North Fork is located on the Lewis and Clark National Forest. The lower 1/2 mile of the North Fork of Deep Creek dries up in some years. Channel gradient is moderate (3-5%) and the streambed is composed of gravel, rubble, and some bedrock. Rock outcrops currently form natural barriers that prevent the upstream migration of hybrid cutthroat trout from the South Fork.

**GAME FISH PRESENT:** Westslope cutthroat trout

**FISHERY:**

Electrofishing studies conducted in 1987 showed that the stream supported 350 cutthroat trout per mile of stream. They range in length from 6 to 10 inches. The only game fish captured were westslope cutthroat trout, a "Species of Special Concern" in Montana. Analyses performed by the University of Montana Genetics Laboratory showed this population to be genetically pure.

**WILDLIFE:**

Big game species using the area include mule deer, elk, black bear, and mountain lion. The Deep Creek drainage is an important elk calving area. Game birds utilizing the drainage include ruffed and blue grouse. Very little waterfowl use occurs on the North Fork Deep Creek. Other important wildlife species include mink, bobcat, and coyote. Various song birds, raptors, and other small mammals are also present.

#### **WETTED PERIMETER:**

The wetted perimeter method was not used on the North Fork Deep Creek. This stream contains a genetically-pure westslope cutthroat trout population which was revealed too late to conduct a wetted perimeter evaluation on the stream.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing population of genetically pure westslope cutthroat, a species of special concern; and to assist in maintenance of habitat for those wildlife species depending upon the stream and its riparian zone for food, water, and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 1.0 cfs (724 A.F./yr.)

A flow recommendation derived from the wetted perimeter method is unavailable for North Fork Deep Creek. The instream flow request is, therefore, based on the fixed percentage method described in Volume 1. Under this method, 27% of the average annual flow is being requested for those Smith River tributaries having high fishery values. An average annual flow of 4.2 cfs was estimated by the USGS for North Fork Deep Creek (see Volume 1, Appendix A). An instream flow of 1 cfs is, therefore, requested.

**STREAM NAME:** Hound Creek

**STREAM REACH:** From the confluence of East Fork Hound Creek and Middle Creek to the mouth -- 26.3 miles

**LOCATION:** Sec. 3D, T14N, R1E to Sec. 20B, T17N, R3E

**DESCRIPTION OF STREAM REACH:**

Hound Creek is located in Cascade County in central Montana. The stream originates in the northwest corner of the Big Belt Mountains. The elevation of the stream ranges from 4,590 feet at the headwaters to 3,495 feet at the mouth.

The stream flows northwest from its headwaters through a deep coulee to its confluence with the Smith River. The entire reach is on private ranch land. The predominant land use is cattle grazing and hay production. There are numerous reservoirs in the headwaters of Hound Creek including: Hound Creek Reservoir, Middle Creek Reservoir and Spring Creek Reservoir. The surrounding area supports large big game herds and commercial outfitting is an important industry. Major tributaries to Hound Creek are East Fork Hound Creek, Pine Coulee, West Fork Hound Creek, Soldier Creek and Spring Creek. Stream substrate consists largely of cobble, gravel and silt. Riparian vegetation consists largely of grasses and some willows.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout, mountain whitefish

**FISHERY:**

Hound Creek supports an average of 1,367 angler-days of use per year based on the 1982-1986 statewide mail survey (McFarland 1989). A 9,110-foot section of Hound Creek was electrofished in March, 1971 (Wipperman 1973) during the Smith River Inventory and Planning Investigation. Rainbow and brown trout were the dominant species; lesser numbers of brook trout were found. Population estimates are presented in Table 3-51.



Table 3-51. Estimated trout population for 9,100 feet of Hound Creek sampled in the spring of 1971.

Species	Length group (in.)	Number per 9,100 ft.
Rainbow trout	6.7 - 14.9	384
Brown trout	7.3 - 23.3	446
Brook trout	6.1 - 11.4	8

#### WILDLIFE:

Big game species using the area include mule and white-tailed deer, elk, antelope, black bear, and mountain lion. Game birds utilizing the drainage include ruffed, blue, sharp-tailed grouse and Hungarian partridge. Occasional waterfowl use occurs on Hound Creek. Other important wildlife species include beaver, muskrat, mink, bobcat, and coyote. Various songbirds, raptors, and other small mammals are present.

#### WETTED PERIMETER:

Cross-sectional data were collected on a 1,000-foot section of Hound Creek (Sec. 25A, T17N, R2E) about 1.5 miles upstream from its confluence with the Smith River. Six cross sections were established. The WETP program was calibrated to field data collected at flows of 21.6, 52.2 and 205.7 cfs.

The relationship between wetted perimeter and flow for a composite of the 6 riffle cross sections is shown in Figure 3-40. An upper inflection point occurs at an approximate flow of 35 cfs.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### FLOW REQUEST:

January 1-December 31 -- 35 cfs (25,339 A.F./Yr.)

# HOUND CREEK

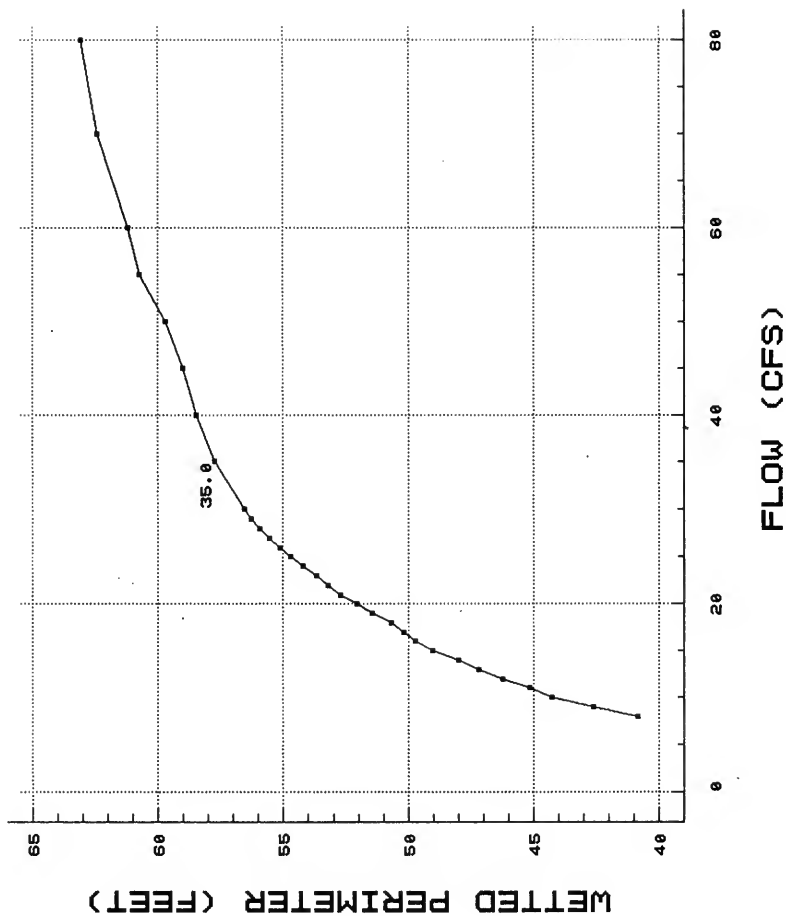


Figure 3-40. The relationship between wetted perimeter and flow for a composite of six riffle cross sections in Hound Creek.

## Sun River Drainage

Figure 3-41 is a map which shows the location of the following streams discussed in this section:

Sun River  
North Fork Willow Creek  
Willow Creek  
Ford Creek  
Elk Creek

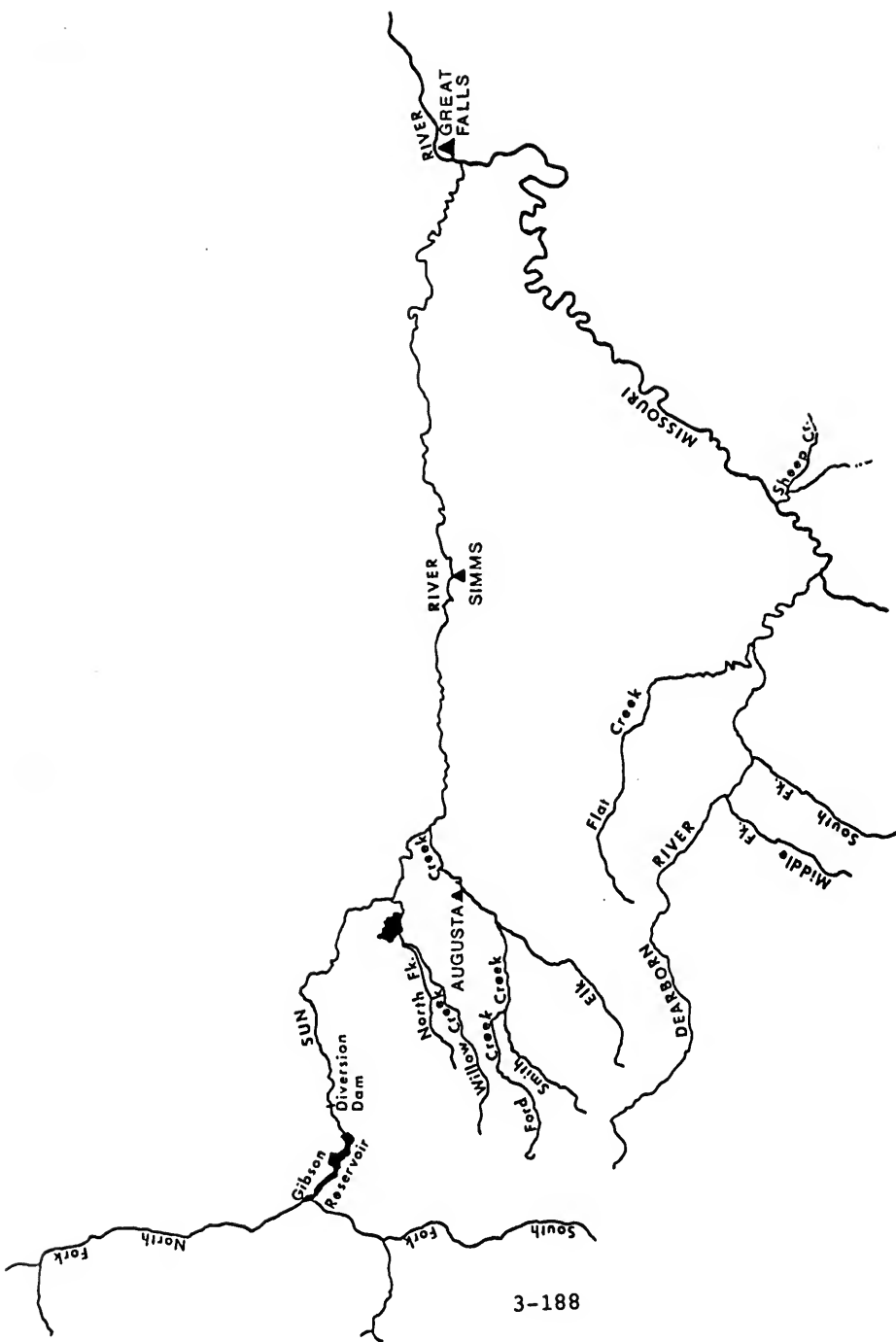


Figure 3-41. Map locating the Sun River Drainage.

**STREAM NAME:** Sun River

**DESCRIPTION OF THE BASIN:**

The Sun River is the second largest tributary of the Missouri River between Canyon Ferry and Fort Peck dams. This west-central mountain stream drains 1,854 square miles of the east slope of the Rocky Mountains.

The Sun River essentially begins downstream of Diversion Dam (elevation 4,400 feet) located 17 miles northwest of Augusta. It then flows east for 97 miles to its confluence with the Missouri River at Great Falls (elevation 3,320 feet). Major tributaries include the North and South forks, Willow, Elk, and Muddy creeks.

Long-term USGS flow records are available for the lower Sun River near Vaughn (located 14 miles upstream from mouth). The average annual flow for a 43-year period of record was 735 cfs. Average monthly flows ranged from 250 cfs in January to 2,987 cfs in June.

Present day flow regimens of the Sun River are largely regulated by Gibson Dam and the associated off-stream storage and irrigation delivery system. This system can accommodate a total diversion of 1,700 cfs from the river. Severe dewatering of the river below the diversion commonly occurs throughout the summer.

The upper Sun River basin is situated in steep limestone and shale mountains within the Lewis and Clark National Forest. Its upper tributaries originate at an elevation of about 8,400 feet and converge at Gibson Reservoir located in the Sun River Gorge. Downstream from Gibson Dam, the river flows for only a few miles to the Diversion Dam impoundment. Below this dam the Sun River exits the mountains onto the prairie zone, first through a series of glacial outwash terraces, then till covered foothills, and, finally, through sedimentary benchlands.

The Sun River Reach #1 begins at Diversion Dam and flows for 32 miles downstream to the confluence of Elk Creek. The river in this reach is entrenched in a very narrow valley about 100 yards wide for the first 12 miles, broadening to about 400 yards wide near the lower end of the reach. Benchlands of shale, limestone, and glacial till flank the river and rise about 100 feet above the floodplain.

Riparian vegetation is sparse in the upper third of this reach because of the narrow floodplain. Only scattered stands of cottonwoods and willows border the river along with an undergrowth of rose and Russian olive. As the floodplain widens in the lower portion of Reach #1, a deciduous woodland dominated by cottonwoods comprises the riparian zone. The stream gradient in the reach is fairly steep, averaging about 20 feet/mile. A considerable amount of the channel substrate in the upper 12 miles is composed of reefs of bedrock and large boulders. Areas of cobbles and gravel are limited and are usually associated with side drainages or near islands. Since the construction of Gibson and Diversion dams in 1929, very little bedload has entered this reach, thereby preventing development of a more diverse substrate composition. Channel substrates diversify somewhat further downstream, and are composed of boulders and cobbles.

Sun River Reach #2 begins at the confluence with Elk Creek and flows for 65 miles downstream to the confluence with the Missouri River at Great Falls. The river in this reach occupies a wide valley. The riparian zone is a cottonwood dominated woodland with rose and willows being the common shrub species found in the understory. The average stream gradient in this lower reach is 9 feet/mile and varies from 17 feet/mile at the upper end to less than 3 feet/mile near the city of Great Falls. The composition of the channel substrate reflects the gradual decrease in stream gradient. Substrate in the upper third of this reach consists mostly of cobbles and gravel with moderate amounts of silt. Further downstream, channel substrate decreases in size and the deposition of silt increases. Below the confluence of Muddy Creek, and for the remaining 17 miles, there is excessive silt deposition. It has been reported that roughly 80-90% of the sediment load of the Sun River at its mouth originates from Muddy Creek (Wheeler, et al. 1987).

The lower 2/3 of this reach is a major recharge area of surplus water resulting from irrigation practices occurring on the benchlands north of the river. Muddy Creek is one of the larger drainages in this area and during the 1987 irrigation season the average monthly discharge of Muddy Creek at its mouth was 219 cfs, totaling about 47% of the Sun River's flow (U.S. Geological Survey 1988).

Land use in the forested upper basin is dominated by wilderness activities. About 2/3 of the upper Sun River basin drains portions of the vast Bob Marshall and Scapegoat wilderness areas. The Forest Service lands outside the wilderness areas are managed for semi-primitive recreation and other multiple uses including oil and gas exploration, livestock grazing, and minor amounts of timber harvesting.

Bordering the Lewis and Clark National Forest is the 19,775-acre Sun River Wildlife Management Area. This area is managed by the Department of Fish, Wildlife and Parks primarily as an elk wintering range. Hay production and livestock grazing are principal uses that occur on the prairie lands of the upper and lower basins. A majority of the land in this area is privately owned, but there is a moderate amount of state and federal land.

The river and surrounding lands downstream from the Forest Service boundary are also important recreation areas. Fishing, hunting, picnicking, and floating are popular activities associated with the river environment.

The Sun River is paralleled by a road for its entire course. Public access to the 97 miles of river is basically limited to seven bridge crossings above Great Falls. About half of the land bordering the 30-mile reach below Diversion Dam is either state or federally owned, however, access to most of these government lands is across private land. The majority of private land owners bordering the Sun River allow access with permission.

Irrigated agriculture is the largest water user in the Sun River basin. Irrigated croplands include hay, alfalfa, and small grains. Irrigation is widespread and intensive throughout the basin. Approximately 140,000 acres of land are irrigated by Sun River waters through 380 miles of lateral canals and ditches (U.S. Geological Survey 1986). Three reservoirs in the drainage store about 162,000 acre-feet and supply water to the system throughout the growing season. A total of 588,243 acre-feet of water was withdrawn and 132,100 acre-feet consumed for irrigation purposes during 1980 (Montana Department of Natural Resources and Conservation 1986).

**STREAM NAME:** Sun River

**STREAM REACH:** #1. From Diversion Dam to the confluence with Elk Creek -- 32 miles

**LOCATION:** Sec. 36B, T22N, R9W to Sec. 6B, T20N, R5W

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish

**FISHERY:**

Rainbow trout and mountain whitefish are the most abundant game fish found in this reach. Brown trout become more abundant in the lower portion of the reach where the gradient lessens. Statistics for these game fish are given in Table 3-52.

Table 3-52. Statistics for game fish populations sampled by electrofishing in a total of 3.5 miles of the upper Sun River, Reach #1, 1987 and 1988.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Rainbow trout	46	7.6	(4.6-17.9)	0.26	(0.02-2.06)
Brown trout	28	11.5	(3.9-23.0)	0.79	(0.02-3.40)
Mountain whitefish	41	11.1	(3.5-18.0)	0.50	(0.02-1.66)

Sizes of trout and whitefish are about average compared to other populations in the state. Non-game species include mountain and longnose suckers, longnose dace, lake chub, and mottled sculpin.

The upper Sun River experiences severe dewatering during the summer when irrigation demand is at its peak. Inadequate stream flows and elevated water temperatures during the summer have suppressed the trout fishery in this reach. There is an excellent potential for improving the fishery if adequate instream flows could be provided. This reach of the Sun River receives a fair amount of fishing pressure.



#### **WILDLIFE:**

Big game species found within the reach include elk, bighorn sheep, mule and white-tailed deer. Grizzly and black bears frequent the area. The grizzly bear is an endangered species under federal law. Ring-necked pheasants are found in the lower portion of this reach where the riparian area broadens. Beaver, mink, muskrat, raccoon, and an occasional river otter are the furbearers inhabiting the riparian area.

#### **WETTED PERIMETER:**

Cross-sectional data were collected at four sites located 1, 4, 5, and 25 miles downstream from Diversion Dam. Six cross sections were established in four riffles. The WETP program was calibrated to field data collected at a low flow of 60 cfs, intermediate flows of 107, 119 and 332 cfs and high flows of 502, 1,355 and 2,500 cfs.

The relationship between wetted perimeter and flow from a composite of six riffle cross sections is shown in Figure 3-42. Lower and upper inflection points occur at approximate flows of 100 and 360 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations; to help provide flows to the lower Sun River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water, and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 100 cfs (72,397 A.F./yr.)

The instream flow corresponding to the lower inflection point is requested for Reach #1. Present fish populations are not exceptionally high and habitat values are low.

# SUN RIVER (reach 1)

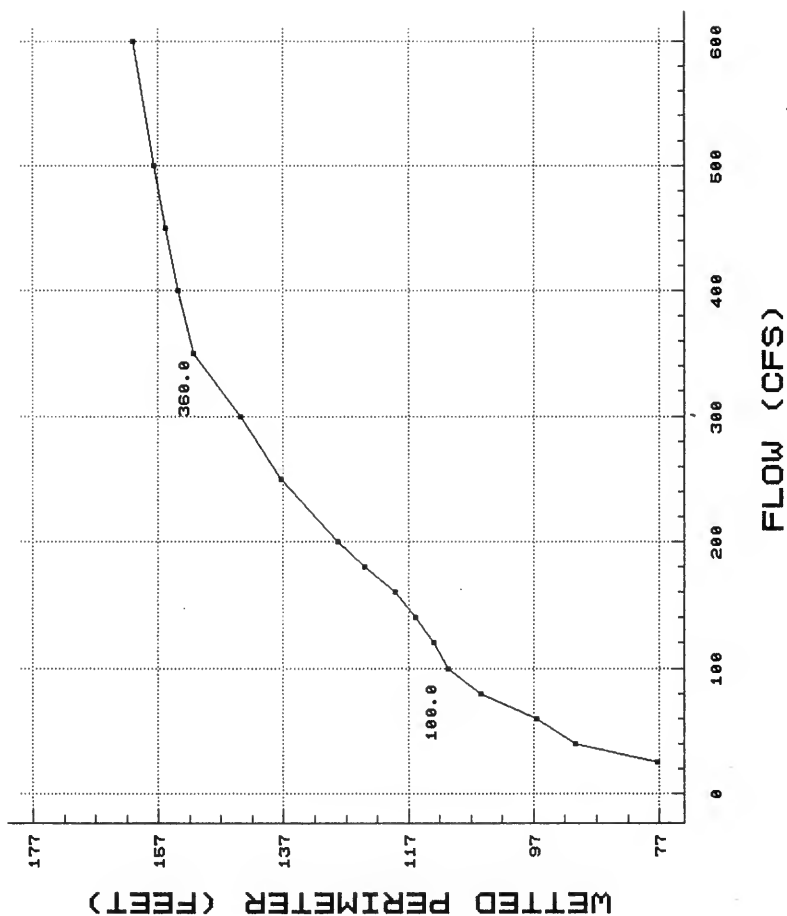


Figure 3-42. The relationship between wetted perimeter and flow for a composite of six riffle cross sections in Reach 1 of the Sun River.

**STREAM NAME:** Sun River

**STREAM REACH:** #2. From confluence with Elk Creek to the mouth - 65 miles

**LOCATION:** Sec. 6B, T20N, R5W to Sec. 11D, T20N, R3E

**GAME FISH PRESENT:** Brown trout, rainbow trout, mountain whitefish, northern pike, burbot

**FISHERY:**

Brown trout are the most abundant game fish found in this reach. Mountain whitefish are fairly common in the upper half of the reach while rainbow trout appear to be uncommon throughout the lower Sun River. A small population of northern pike and burbot reside in the lower 25 miles of the river. Statistics for the salmonid game fish are given in Table 3-53.

Table 3-53. Statistics for game fish populations sampled by electrofishing in a total of 10.5 miles of the middle Sun River, Reach #2, 1987 and 1988.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Brown trout	95	13.5	(3.4-23.1)	1.27	(0.02-4.32)
Rainbow trout	13	12.0	(4.7-17.2)	0.69	(0.03-2.30)
Mountain whitefish	47	10.0	(3.3-16.6)	0.44	(0.02-1.54)

Fish survey information indicated the brown trout population is well represented by large size fish, while rainbow trout and whitefish sizes are about average compared to other populations in the state. Non-game species found in the reach include common carp, mountain, longnose and white suckers, longnose dace, lake chub, and mottled sculpin.

The lower Sun River experiences severe dewatering during the summer when irrigation demand is at its peak. Inadequate stream flows and elevated water temperatures during the summer have limited the fishery to short river segments where irrigation return flows and seepages provide marginal stream flow conditions for trout. There is an excellent potential

for improving the fishery if adequate instream flows could be provided. The Sun River receives a fair amount of fishing pressure in this reach.

#### **WILDLIFE:**

Big game species found within the reach include mule and white-tailed deer. Ring-necked pheasants are found throughout the reach along with beaver, mink, muskrat, raccoon, and an occasional river otter.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 1,200-foot section located near Simms (Sec. 12D, T20N, R3W). Two cross sections were established in one riffle. The WETP program was calibrated to field data collected at flows of 168, 297 and 561 cfs.

The relationship between wetted perimeter and flow from a composite of two riffle cross sections is shown in Figure 3-43. Lower and upper inflection points occur at approximate flows of 130 and 220 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water, and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 130 cfs (94,116 A.F./yr.)

The instream flow corresponding to the lower inflection point is requested for Reach #2. Present fish populations are not exceptionally high and, therefore, this stream reach does not warrant the high level of aquatic habitat protection.

# SUN RIVER (reach 2)

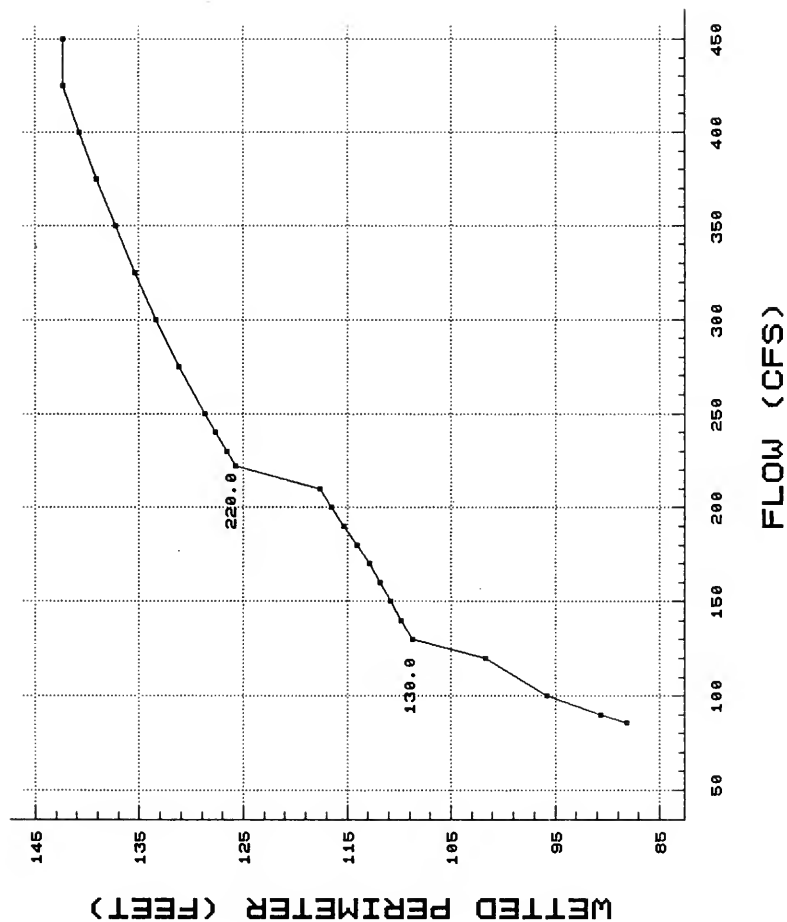


Figure 3-43. The relationship between wetted perimeter and flow for a composite of two riffle cross sections in Reach 2 of the Sun River.

**STREAM NAME:** North Fork Willow Creek

**STREAM REACH:** From the headwaters to the mouth -- 10.5 miles

**LOCATION:** Sec. 7C, T20N, R8W, to Sec. 27D, T21N, R7W

**DESCRIPTION OF STREAM REACH:**

The North Fork Willow Creek originates near the Lewis and Clark National Forest boundary approximately 13 miles west of Augusta. The upper reaches flow through a foothills section and are characterized by fairly steep gradient with streambed materials of gravel to large cobble. The remainder of the stream flattens out through a narrow valley surrounded by gently rolling hills. Stream bottom consists of gravel, cobble and muck associated with beaver dams. Overall stream gradient averages 156 feet/mile. Water clarity is generally good. Larger tributaries include Cutrock Creek and Barr Creek.

The riparian area consists of scattered conifers in the upper portions and dense willow stands in the middle and lower portions. Land use beyond the riparian area is for pasture and hay. Land ownership is 90% private and 10% state. Access is mostly across trails on private lands, with permission granted on a limited basis. One county road crosses the stream in the lower portion. Historical land uses include agriculture, recreation and for fall and spring elk migrations to and from the Sun River Wildlife Management Area. There are two small irrigation diversions from the North Fork Willow Creek.

**GAME FISH PRESENT:** Brook trout

**FISHERY:**

North Fork Willow Creek supports good numbers of brook trout, which comprise 100% of the game fish. Other fish present are mottled sculpin. A survey conducted in September, 1971 in a 325-foot section in Sec. 2C, T20N, R8W produced 33 brook trout 2.6 -12.1 inches in length.

#### **WILDLIFE:**

Big game animals found in the area include elk, mule deer, white-tailed deer, pronghorn antelope, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland game birds include Hungarian partridge, sharp-tailed grouse, blue grouse, ruffed grouse and spruce grouse. Furbearers include coyote, bobcat, mink, beaver and muskrat. A variety of raptors are also found here.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a section of the North Fork Willow Creek about 10 miles northwest of Augusta (Sec. 2C, T20N, R8W). Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 2.8, 2.9 and 4.3 cfs. However, flows did not fluctuate enough to allow use of the wetted perimeter method. The stream has a relatively stable flow regime which more closely resembles a spring creek than a typical mountain stream.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing brook trout population, including spawning and rearing habitat. Wildlife species that depend upon the stream and riparian zone for food, water and shelter will also benefit from the flows. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of North Fork Willow Creek.

#### **FLOW REQUEST:**

January 1 - December 31 -- 3.0 cfs (2,172 A.F./yr.)

This stream has a relatively stable flow pattern. Flows of 2.8, 2.9 and 4.3 cfs were measured during the study. The USGS estimated the base flow at 3 cfs. Based on these data, a flow of 3.0 cfs is considered the base flow for the stream and is requested to maintain the existing fishery.

**STREAM NAME:** Willow Creek

**STREAM REACH:** From the headwaters to the mouth -- 15 miles

**LOCATION:** Sec. 26B, T20N, R9W to Sec. 26A, T21N, R7W

**DESCRIPTION OF STREAM REACH:**

Willow Creek originates on the Lewis and Clark National Forest approximately 16 miles southwest of Augusta. The upper portion flows through a mountainous area, transforms into a foothills section, and finally flows through rolling hills to its confluence with Willow Creek Reservoir. Substrate varies from cobbles and boulders in the upper reaches to gravel, cobbles and silt in the lower reaches. Stream gradient averages about 78 feet/mile. Water clarity is good. Willow Creek has two tributaries, Little Willow Creek and North Fork Willow Creek.

USGS discharge records are available from June 1905 through September 1925. The gauge was located 5 miles northwest of Augusta, below the mouth of the North Fork Willow Creek. The maximum discharge was 1,150 cfs on June 23, 1916. The average annual discharge for the period of record was 27.7 cfs or 20,050 acre-feet per year.

The riparian area varies from conifers and aspen to dense willow stands. Land use beyond the riparian area is national forest, pasture and hay meadows. Historical land and water use includes agriculture, recreation and elk migrations to and from winter range. Land ownership is 83% private and 17% public (national forest, state, and Bureau of Reclamation). Stream access is available on the national forest and at one county road crossing. Limited access is granted on private lands. There are several small irrigation diversions from the stream.

**GAME FISH PRESENT:** Brook trout and rainbow trout

**FISHERY:**

The fishery in Willow Creek is mostly brook trout with a few rainbow trout. Results of electrofishing surveys conducted in 1971 are presented in Table 3-54. Other species present in the stream include mottled sculpin, white sucker and longnose sucker.



Table 3-54. Survey electrofishing data for 275 feet of Willow Creek, September 1971 (Sec. 14D, T20N, R8W).

Species	Number Captured	Length Range (in.)
Brook trout	14	3.5 - 11.6
Rainbow trout	2	6.1 - 8.2

#### WILDLIFE:

Big game animals using the stream and associated riparian zone include bighorn sheep, elk, mule deer, white-tailed deer, antelope, black bear, and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include spruce grouse, blue grouse, ruffed grouse, Hungarian partridge, and sharp-tailed grouse. Furbearers include beaver, mink, muskrat, coyote and bobcat. A variety of raptors also occur in the reach.

#### WETTED PERIMETER:

Cross-sectional data were collected in a section of Willow Creek approximately 9 miles west of Augusta (Sec. 14D, T20N, R8W). Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 3.1, 3.7 and 12.4 cfs.

The relationship between wetted perimeter and flow for a composite of four riffle cross sections is shown in Figure 3-44. An upper inflection point occurs at approximately 3 cfs.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing trout populations, including spawning and rearing habitat. Wildlife species that depend upon the stream and riparian zone for food, water and shelter will also benefit from the flows. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of Willow Creek.

#### FLOW REQUEST:

January 1 - December 31 -- 3 cfs (2,172 A.F./yr.)

# WILLOW CREEK

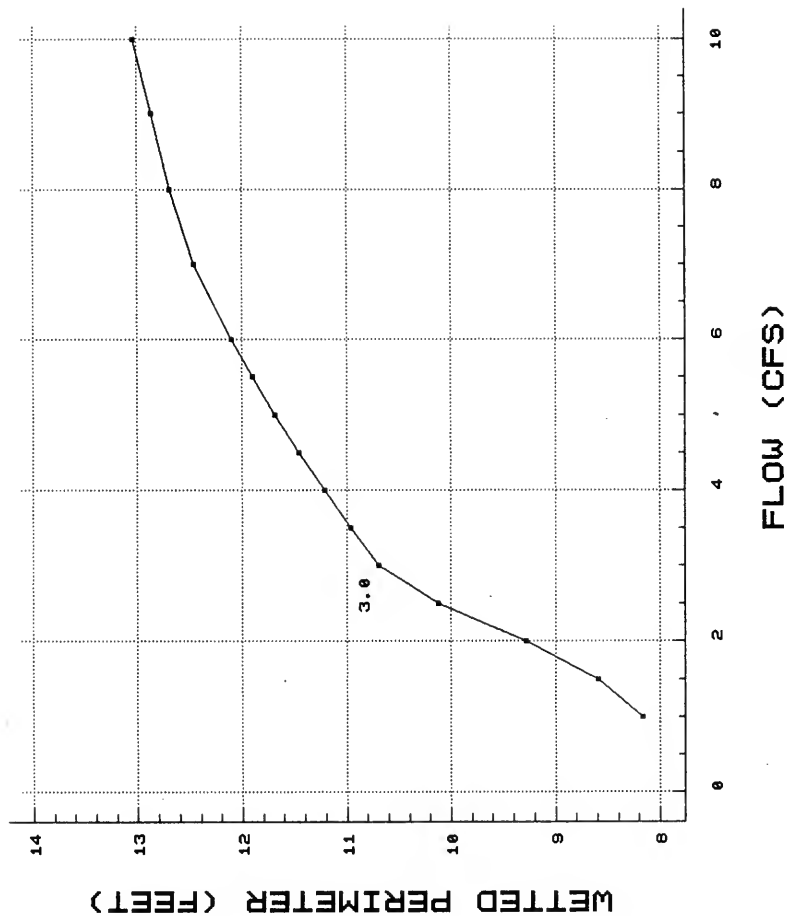


Figure 3-44. The relationship between wetted perimeter and flow for a composite of four rifle cross sections in Willow Creek.

**STREAM NAME:** Ford Creek

**STREAM REACH:** From the headwaters to the mouth -- 12 miles

**LOCATION:** Sec. 16A, T19N, R9W, to Sec. 36D, T20N, R8W

**DESCRIPTION OF STREAM REACH:**

Ford Creek originates on the Lewis and Clark National Forest approximately 18 miles southwest of Augusta. The stream begins in a mountainous area, changing to a foothills section and finally flows through rolling hills to its confluence with Smith Creek. Substrate varies from boulders and cobbles to gravel and silt. Stream gradient is nearly 100 feet/mile. Ford Creek has 1 tributary, the North Fork of Ford Creek.

USGS discharge records are available for Ford Creek from April 1906 through December 1912. The gauge was located on the old Ford Ranch, 14 miles southwest of Augusta. The maximum discharge was 1,230 cfs on June 19, 1909. The average annual discharge was 32.2 cfs or 23,310 acre-feet per year for the period of record.

The riparian area consists of conifers, aspen and willows in the mountainous section and dense willow stands plus a few aspen and cottonwoods in the remaining portions.

Lands beyond the riparian area consist of national forest, pasture and hay meadows. Land ownership is 60% private and 40% public (state and national forest). Stream access is available on the national forest and on a limited basis on private lands. An all weather road parallels the stream portion on forest lands. Historical land and water uses include agriculture and recreation. There is one private irrigation diversion. Water is also diverted to Nilan Reservoir.

**GAME FISH PRESENT:** Rainbow trout, cutthroat trout, brook trout

**FISHERY:**

The fishery in Ford Creek is approximately 90% brook trout and 10% rainbow and cutthroat trout. Brook trout up to 1.25 pounds have been recorded. Surveys from several locations and several years from 1971 to 1986 show the stream supports a good population of brook trout up to 13.5 inches in length as well as a few rainbow and cutthroat trout up to 11.5 inches in length. Mottled sculpin also occur in the stream.

#### **WILDLIFE:**

Big game using the stream and riparian area include bighorn sheep, elk, mule deer, white-tailed deer, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include sharp-tailed grouse, Hungarian partridge, ruffed grouse, blue grouse and spruce grouse. Furbearers include coyote, bobcat, mink, beaver and muskrat. Several species of raptors also utilize the area.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a section of Ford Creek approximately 13 miles southwest of Augusta (Sec. 32B, T20N, R8W). Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 11.0, 14.6 and 23.4 cfs.

The relationship between wetted perimeter and flow for a composite of four riffle cross sections is shown in Figure 3-45. Lower and upper inflection points occur at approximate flows of 6 and 12 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations including their spawning and rearing habitat. Wildlife species that depend upon the stream and riparian zone for food, water and shelter will also benefit from the flow. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of Ford Creek.

#### **FLOW REQUEST:**

January 1 - December 31 -- 12 cfs (8,688 A.F./yr.)

# FORD CREEK

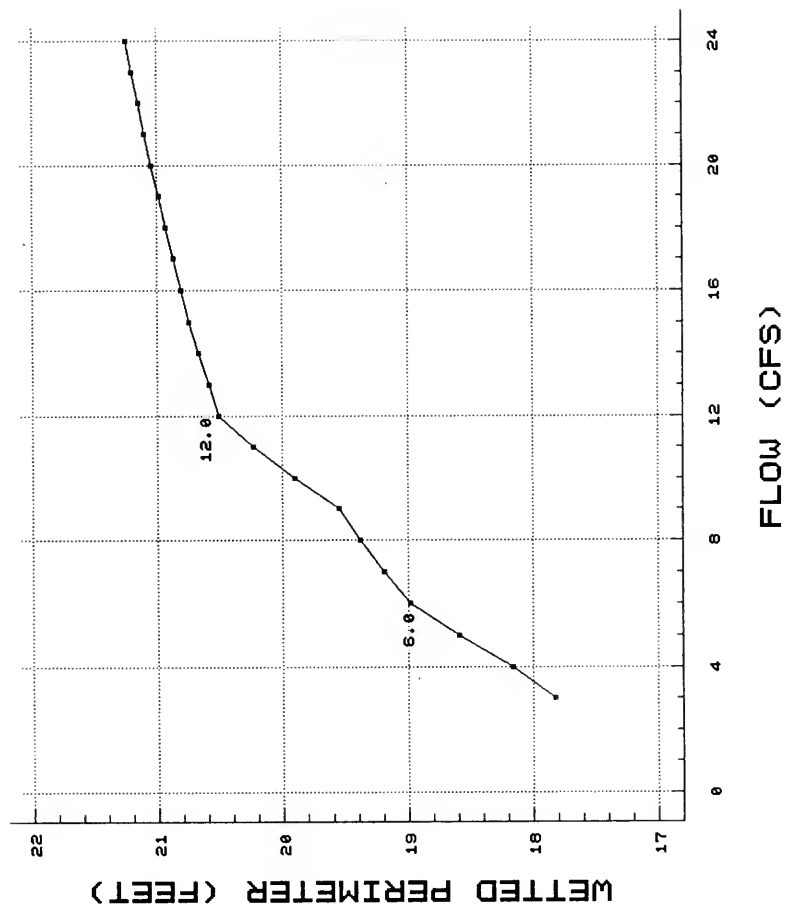


Figure 3-45. The relationship between wetted perimeter and flow for a composite of four rifle cross sections in Ford Creek.

**STREAM NAME:** Elk Creek

**STREAM REACH:** From the headwaters to the mouth -- 25 miles

**LOCATION:** Sec. 10D, T18N, R8W, to Sec. 6B, T20N, R5W

**DESCRIPTION OF STREAM REACH:**

Elk Creek originates on the Lewis and Clark National Forest approximately 17 miles southwest of Augusta. The upper reaches flow through a mountainous section. After leaving the mountains, the stream enters a foothills area which is followed by a more gently rolling hills/flatland reach. Stream substrate is mostly gravel and cobble. Stream gradient approaches 50 feet/mile. Water clarity is good. Important tributaries include Blubber Creek and Sixth Creek.

USGS discharge records for Elk Creek are available from October 1904 through November 1924. The station was located at the old highway bridge near Augusta. The maximum discharge was 4,300 cfs on June 2, 1908. The average annual discharge was 94.4 cfs or 68,340 acre-feet per year.

The riparian area varies from conifers and aspen in the upper reaches to cottonwoods and willows in the middle and lower reaches.

Lands beyond the riparian area consist of national forest, pasture and hayland. Land ownership is 75% private and 25% public (state and national forest). The stream is accessed by two highway and eight county road bridges. There are also several private road crossings. A county road parallels and crosses Elk Creek from Augusta to the headwaters. Historical land and water uses include agriculture and recreation. Presently there are several small irrigation diversions on Elk Creek.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

Elk Creek is one of the most important trout fisheries in the Augusta area. The trout population is nearly equally divided between rainbow trout, brown trout, and brook trout throughout most of the reach. Brook trout are somewhat more abundant in the uppermost reaches. Other species found in Elk Creek

include mottled sculpin, longnose dace, longnose sucker and white sucker.

The trout population was censused on August 24, 1987, using snorkel survey techniques. The results appear in Table 3-55.

Table 3-55. Snorkel survey results for 495 feet of Elk Creek, Aug. 24, 1987 (Sec. 10A, T19N, R7W).

Species	No. Fish < 6"	No. Fish >6"	Total
Rainbow trout	27	41	68
Brown trout	4	2	6
Brook trout	3	--	3

Problems associated with the fishery in Elk Creek include dewatering of some of the lower reaches.

#### WILDLIFE:

Big game animals using the stream and riparian area include elk (upper portions only), white-tailed deer, mule deer, pronghorn antelope, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include all three species of mountain grouse (blue, ruffed and spruce), Hungarian partridge, sharp-tailed grouse and ring-necked pheasant. Furbearers include coyote, fox, mink, beaver and muskrat. Other wildlife species include several several species of raptors and waterfowl.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 150-foot section of Elk Creek approximately 6 miles southwest of Augusta (Sec. 10A, T19N, R7W). Four riffle cross sections were established. One cross section was not used because of calibration problems. The WETP computer program was calibrated to field data collected at flows of 29.0, 45.9 and 171.0 cfs.

The relationship between wetted perimeter and flow for a composite of three riffle cross sections is shown in Figure 3-46. An upper inflection point occurs at an approximate flow of 16 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations along with their spawning and rearing habitat. These flows will also help protect those wildlife species which depend upon the stream and its riparian zone for food, water and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of Elk Creek.

**FLOW REQUEST:**

January 1 - December 31 -- 16 cfs (11,583 A.F./yr.)



# ELK CREEK

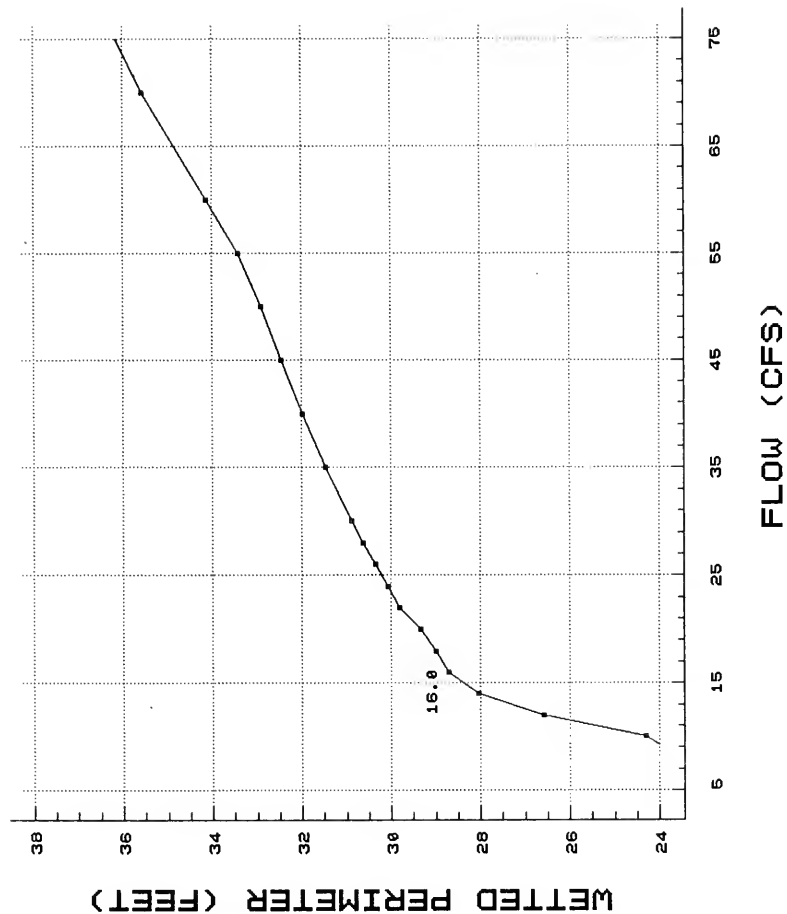


Figure 3-46. The relationship between wetted perimeter and flow for a composite of three rifle cross sections in Elk Creek.



## Belt Creek Drainage, Highwood and Shonkin Creeks

Figure 3-47 is a map which shows the location of the following streams discussed in this section:

Belt Creek	Logging Creek
Dry Fork Belt Creek	Big Otter Creek
Tillinghast Creek	Highwood Creek
Pilgrim Creek	Shonkin Creek



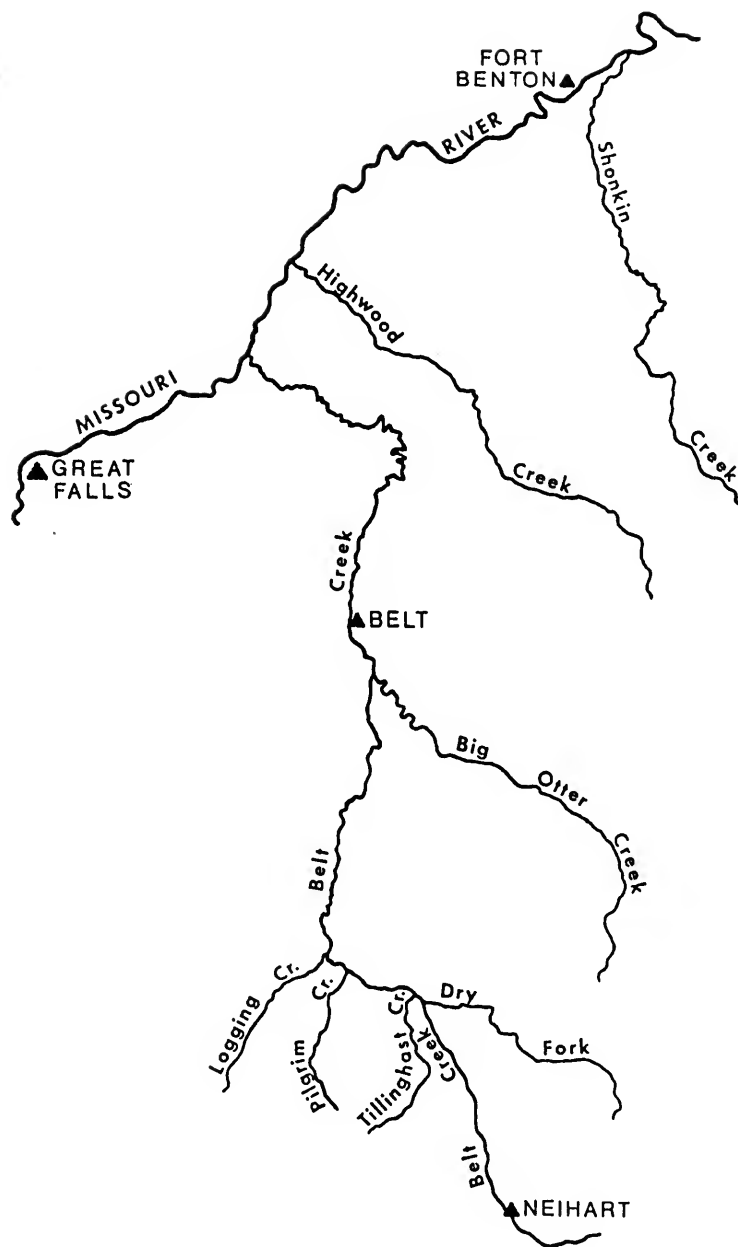


Figure 3-47. Location map for the Belt Creek drainage, Highwood and Shonkin Creeks.

**STREAM NAME:** Belt Creek

**DESCRIPTION OF THE BASIN:**

Belt Creek is a major tributary of the Missouri River. It originates on the northwest side of the Little Belt Mountains and flows in a northerly direction for about 81 miles to its confluence with the Missouri 14 miles downstream of Great Falls in Cascade County. Belt Creek drains about 800 square miles of the Little Belt and Highwood mountains. Major tributaries to Belt Creek include Jefferson, Dry Fork, Tillinghast, Pilgrim, Logging, Big Otter, Little Belt and Big Willow creeks.

The upper basin of Belt Creek is situated in the mountainous area of the Lewis and Clark National Forest with its headwaters at an elevation of about 8,000 feet. The landscape of the headwaters is comprised of plateau-like mountains with V-shaped valleys carved through the sedimentary Belt formation of the parent rock.

The basin supports subalpine and montane forests consisting mostly of lodge pole pine, Douglas fir, ponderosa pine, and subalpine fir. Within these forest zones, the upper 33 miles of Belt Creek flows through a steep, narrow valley before entering the Sluice Boxes, a limestone gorge about 14 miles in length.

The riparian vegetation of the floodplain is variable with respect to elevation, consisting of an overstory of spruce and lodgepole pine in the cool, higher areas and lodgepole pine, Douglas fir, ponderosa pine and cottonwood in the lower temperate zone. Willows, water birch, rose, and red osier dogwood are shrub species which dominate the undergrowth of the riparian. There are very few meadow areas along Belt Creek.

The gradient for this size of stream is unusually steep, averaging about 90 feet/mile near its headwaters at Neihart, to 40 feet/mile at the lower end near Monarch. Channel substrates reflect the cascading nature of Belt Creek with boulders, large cobbles, and several outcroppings of bedrock typifying the stream bottom.

Lower Belt Creek flows through prairie foothills and benchlands joining the Missouri River at an elevation of 2,800 feet. This lower section begins at the confluence with Big Otter Creek and flows for 39 miles through gently dipping sandstone and shale formations while remaining entrenched within a narrow valley. The upper 13 miles of this reach

typically are intermittent during dry periods, probably losing water to cavernous limestone. Downstream of this point, the stream becomes effluent again and remains perennial throughout its remaining course.

The riparian vegetation consists of a diverse woodland environment dominated by a cottonwood overstory with an undergrowth of willows, chokecherry, rose and snowberry. Although the stream gradient lessens from that of upper Belt Creek, the average gradient of 28 feet/mile is unusually steep for a large prairie stream. Channel substrate is comprised primarily of cobbles, although scattered boulders are still present throughout its length. Cobbles and gravel in the lower end show increased silt deposits due to heavy sediment loads entering from lowland tributaries.

Land use in the Belt Creek drainage includes most types found east of the Divide. Timber harvest has been extensive in the past, however, a harvest of only about 3.7 million board feet is planned within the next 8 years (U.S. Forest Service 1986). Nearly all of the land within the lower basin is managed for cattle ranching or farming. A substantial amount of livestock grazing occurs in this area. Only minor grazing occurs in the forested upper basin. Haylands and some croplands exist along the stream, but little of it is irrigated.

There has been extensive silver, lead, zinc and gold mining in the Little Belt mountains. Exploration and production are ongoing and will probably increase in the future when market conditions improve (U.S. Forest Service 1986). Along with the mining of various ore deposits, serious heavy metals pollution from several abandoned mining sites has somewhat impaired water quality in Belt Creek (Briaco and Botz 1974).

Belt Creek has a high scenic value. It is a popular recreation area for fishing, hunting, picnicking, camping, hiking and floating. There is a ski and winter sports area located in the upper basin. Several summer homes are located along the stream within the national forest. U.S. Highway 89 parallels Belt Creek throughout the upper section and provides access to most portions of the stream. County highways 331 and 228 parallel the stream for about 25 miles of the lower section. Public access to private lands bordering lower Belt Creek is usually allowed with permission. The remaining 14 miles of this lower portion flows through remote and rugged lands and access is difficult.

A USGS gauge on Belt Creek near Monarch (river mile 52.0) recorded an average annual flow of 192 cfs for the 31-year period of record between 1951-82.

**STREAM NAME:** Belt Creek

**STREAM REACH:** #1. From headwaters to Big Otter Creek -- 51 miles

**LOCATION:** Sec. 27D, T13N, R8E to Sec. 6C, T18N, R7E

**GAME FISH PRESENT:** Rainbow trout, mountain whitefish, brown trout,  
brook trout, cutthroat trout

**FISHERY:**

Rainbow trout are the predominant fish found throughout the reach followed by mountain whitefish and brown trout. Cutthroat and brook trout are uncommon in the mainstem, but good populations are present in some tributary streams and headwater areas. Non-game species include mountain, white and longnose suckers, longnose dace, and mottled sculpin.

A population estimate was made in September 1986 in a 2,100-foot section of Belt Creek just downstream of the Sluice Box Gorge. Standing crop estimates for rainbow and brown trout and mountain whitefish are given in Table 3-56. Total trout numbers were estimated at 1,214 fish/mile. This is considered an abundant population for smaller streams in this area.

Table 3-56. Size statistics and standing crop estimates for fish populations in Belt Creek, 1/2 mile upstream from the Riceville Bridge, September, 1986.\* (80% confidence intervals in parentheses).

Species	Number Captured	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Rainbow trout	130	7.3	(2.2-15.5)	0.19	(0.01-1.48)	202 (± 103)
Brown trout	35	10.4	(2.8-20.0)	0.76	(0.01-3.15)	28 (± 16)
Mtn whitefish	45	13.2	(3.7-18.3)	0.93	(0.01-2.32)	36 (± 17)

\* Fish less than 4 inches were excluded from average size analyses.

Belt Creek receives a substantial amount of fishing pressure probably because of its close proximity to Great Falls and the convenient access provided by Highway 89. The statewide fishing pressure and harvest survey for the period 1982-86 reported an average of about 8,000 angler-days of use annually (McFarland 1989).



Because of the substantial fishing pressure and the dewatering problem which occurs in the lower portion of this reach, the lower 13 miles does not maintain an adequate self-sustaining trout population. About 3,000 catchable rainbow trout are stocked in this section annually.

#### **WILDLIFE:**

Big game species found within the study reach include black bear, elk, mule and white-tailed deer and mountain lion. Game birds present are blue and ruffed grouse. Mallard ducks use the stream and slough areas throughout the ice-free period. Beaver, mink, muskrat and raccoon are common furbearers. This area has a high value for raptors because of the extensive steep cliff areas and a remote 14-mile section of stream. Some of the raptors commonly observed are bald and golden eagles, prairie falcon, American kestrel and Swainsons and redtail hawks.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 2,000-foot section located about 1/2 mile upstream of the Riceville Bridge (Sec. 26C, T17N, R6E). Four cross sections were established in two riffles. Two cross sections were not used due to calibration problems. The WETP program was calibrated to field data collected at flows of 88, 211 and 586 cfs.

The relationship between wetted perimeter and flow for a composite of two riffle cross sections is shown in Figure 3-48. An upper inflection point occurs at an approximate flow of 90 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout populations; to provide water to the lower reaches where dewatering is sometimes severe; to dilute toxic pollutants from mining wastes; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 90 cfs (65,157 A.F./yr.)

# BELT CREEK (reach 1)

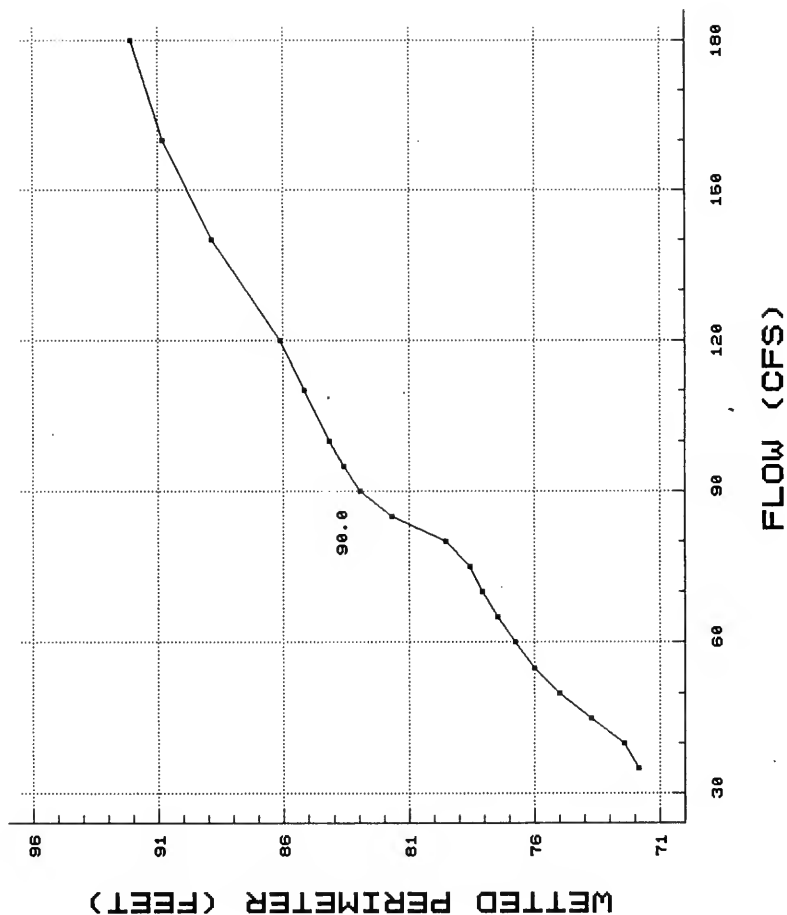


Figure 3-48. The relationship between wetted perimeter and flow for a composite of two rifle cross sections in Reach 1 of Belt Creek.

**STREAM NAME:** Belt Creek

**STREAM REACH:** #2. From Big Otter Creek to the confluence with the Missouri River -- 39 miles

**LOCATION:** Sec. 6C, T18N, R7E to Sec. 2D, T21N, R5E

**GAME FISH PRESENT:** Sauger, rainbow trout, brown trout, mountain whitefish

**FISHERY:**

This reach of Belt Creek supports both coldwater and warmwater fisheries. A marginal resident trout fishery exists in this reach and is probably limited because of low stream flows, high water temperatures and excessive siltation. Rainbow trout are the most common trout species found. Brown trout occur throughout the reach, but in far fewer numbers. To some extent both rainbow and brown trout from the Missouri River migrate up Belt Creek during their spawning season. Mountain whitefish also migrate into Belt Creek from the Missouri River to spawn. Several hundred whitefish were observed in about a mile section of lower Belt Creek during the fall of 1981 (Berg 1982).

Sauger migrate up Belt Creek during the late spring and reside in the stream until fall as long as flow conditions are adequate. During the late summer of 1963, 81 sauger were trapped as they moved downstream. The sizes of these fish ranged between 12 and 16 inches in length.

Non-game fish found in lower Belt Creek include goldeye, longnose, mountain and white suckers, shorthead redhorse, carp and mottled sculpin.

**WILDLIFE:**

Wildlife commonly associated with the riparian zone include mule and white-tailed deer, ring-necked pheasant, raccoon, mink, muskrat and beaver and a variety of songbirds. The lower portion of this reach provides critical habitat for wintering bald eagles, migrating waterfowl, nesting herons, ospreys and golden eagles.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 600-foot section near the confluence of Big Willow Creek (Sec. 13, T20N, R6E). Five cross sections were established. The WETP program was calibrated to field data collected at flows of 94, 152, and 268 cfs.

The relationship between wetted perimeter and flow from a composite of the five cross sections is shown in Figure 3-49. Lower and upper inflection points occur at flows of 35 and 75 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain existing trout and warmwater fisheries; to provide flows that will help support spawning migrations; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 35 cfs (25,339 A.F./yr.)

The lower inflection point flow is requested for Reach #2 because the aquatic habitat values are rated as low.

# BELT CREEK (reach 2)

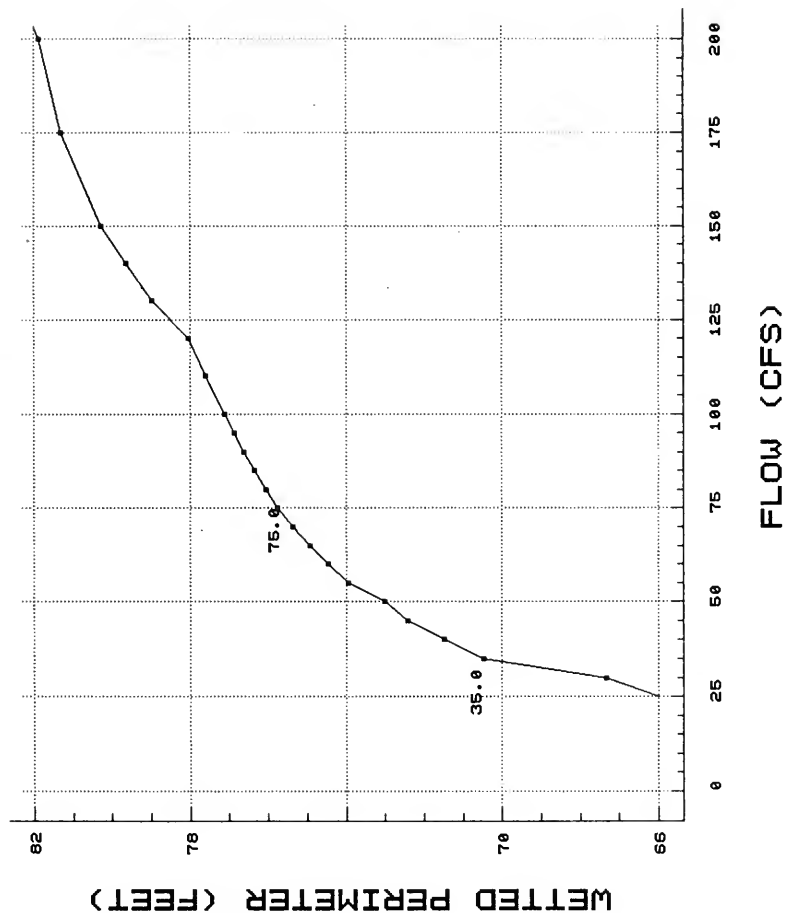


Figure 3-49. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 2 of Belt Creek.

**STREAM NAME:** Dry Fork Belt Creek

**STREAM REACH:** From the confluence of Galena and Oti Park Creeks to the confluence with Belt Creek -- 11 miles

**LOCATION:** Sec. 13D, T15N, R8E to Sec. 33D, T16N, R7E

**DESCRIPTION OF STREAM REACH:**

The Dry Fork of Belt Creek is located in Cascade County within the Lewis and Clark National Forest. It originates at the confluence of Galena and Oti Park creeks at the north end of the Little Belt Mountains (elevation 5,450 feet) and flows northwesterly for 11 miles to its confluence with Belt Creek at Monarch (elevation 4,260 feet). Primary tributaries to Dry Fork Creek include Spruce, Galena and Sawmill creeks, and Blankenship Gulch. The landscape of the basin varies from moderate to steeply sloping limestone mountains which support a montane forest.

The Dry Fork flows through a moderately wide canyon. The riparian area consists of a Douglas fir, ponderosa pine and cottonwood overstory with an undergrowth of water birch, willows and rose. This is a steep gradient stream, exhibiting a grade of about 133 feet/mile. The channel substrate reflects the cascading nature of the stream. Boulders and cobbles are the dominate streambed substrate. Siltation occurs in the slower water areas, probably a result of erosion in the old mine spoils area of Galena Creek.

The U.S. Forest Service manages the lands within the basin for timber harvest, livestock grazing, mining and recreation. The Oti Park Creek basin, a subbasin of the Dry Fork, is managed for semi-primitive recreation opportunities.

**GAME FISH PRESENT:** Rainbow trout, cutthroat trout, brook trout

**FISHERY:**

Rainbow, brook and cutthroat trout are commonly found in the headwater tributaries of the Dry Fork. Downstream of Galena Creek trout populations are very low. This is attributed to the toxic effect of heavy metals pollution originating from abandoned hard rock mining sites located along Galena Creek. Vandenberg (1974) studied the impacts these abandoned mining sites had on the aquatic fauna of Galena and Dry Fork creeks.

He found severe reductions in the aquatic insect communities and related these impacts to heavy metals pollution draining from the abandoned mining areas.

The fish populations in the Dry Fork 1/2 mile above the mouth was surveyed and results are given in Table 3-57.

Table 3-57. Size statistics and numbers of trout sampled by electrofishing in 600 feet of Dry Fork Belt Creek, September 1987.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Rainbow trout	11	5.8	(4.9-7.8)	0.09	(0.04-0.20)
Brook trout	5	6.0	(5.3-6.6)	0.08	(0.06-0.09)

\* Fish less than 4 inches were excluded from average size analyses.

Fish populations appear to be far less abundant than those of nearby streams. The Dry Fork appears to have good instream flows and habitat conditions for rainbow and cutthroat trout. There is a good potential for restoration of the trout fishery when these abandoned mining sites are reclaimed.

#### WILDLIFE:

Big game species found within the basin include black bear, elk and mule deer. Game birds include ruffed and blue grouse. Mink and beaver are common furbearers.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 268-foot section about 1/2 mile upstream from the mouth (Sec. 3A, T15N, R7E). Five cross sections were established in 3 riffles. The WETP program was calibrated to field data collected at flows of 9.1, 22.2 and 29.7 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-50. An upper inflection point occurs at an approximate flow of 7 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing fishery; to provide flow for improving the fishery once the mining waste sites are reclaimed; to dilute mine waste pollution from Galena Creek; to provide flows for Belt Creek; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1 - December 31 -- 7 cfs (5,068 A.F./yr.)



# DRY FORK CREEK

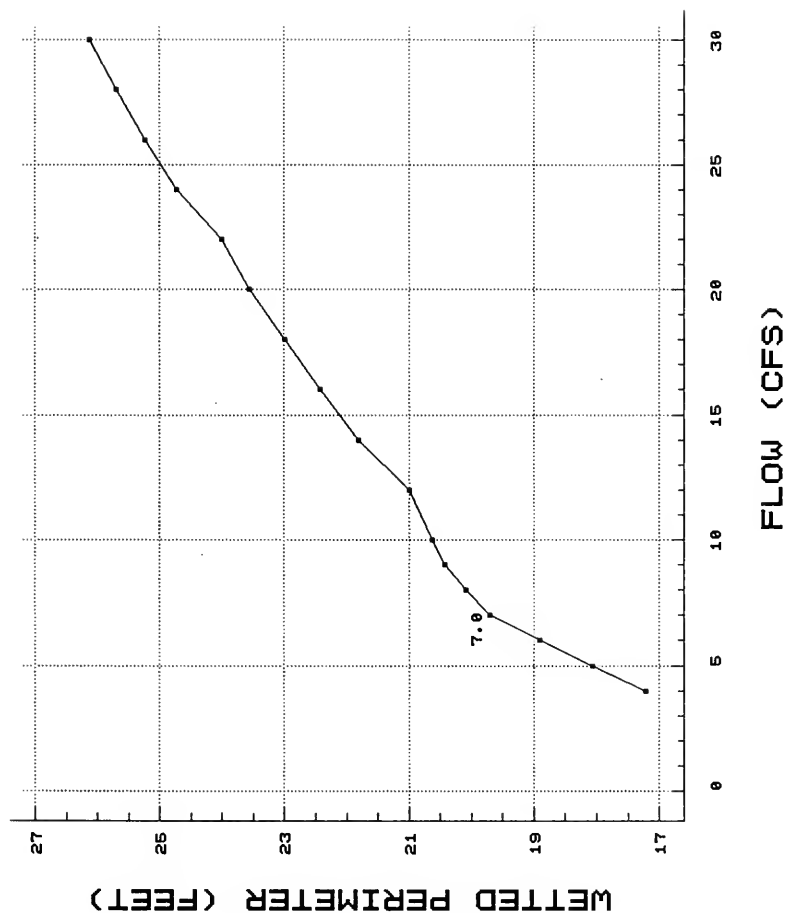


Figure 3-50. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Dry Fork Belt Creek.

**STREAM NAME:** Tillinghast Creek

**STREAM REACH:** From the headwaters to the confluence with Belt Creek -- 13 miles

**LOCATION:** Sec. 28B, T14N, R7E to Sec. 33C, T16N, R7E

**DESCRIPTION OF STREAM REACH:**

Tillinghast Creek is located in Cascade County, originating in the Little Belt Mountains (elevation 6,000 feet) within the Lewis and Clark National Forest. It flows northerly for 13 miles to its confluence with Belt Creek about 1 mile downstream of Monarch (elevation 4,520 feet). Major tributaries are James and Horn creeks. The landscape of the basin varies from gently sloping benchlands to steeply sloping limestone mountains which support both montane forests and parkland environments.

Tillinghast Creek is comprised of two distinct sections based on land form characteristics. The upper 9 miles flow through a narrow wooded valley flanked by benches and foothills which support a parkland environment. The riparian zone is a mixed woodland of conifers and aspen. The lower 4 miles flow through a steep forested limestone canyon. The floodplain within the canyon consists of a woodland dominated by Engelmann spruce and lodgepole pine overstory. A few cottonwoods and water birch are interspersed within the upper canopy. The undergrowth is a shrubby layer dominated by willows and red osier dogwood. The stream gradient is steep, dropping 104 feet/mile. The channel substrate is composed of boulders, cobbles and gravel. The lower 1/2 mile of Tillinghast typically loses water and becomes intermittent during the summer, probably the result of water seepage into the cavernous limestone underlying the stream in this area.

Most of the drainage is a mountainous Douglas fir forest managed primarily for livestock grazing by the U.S. Forest Service. About 1/3 of the basin is privately owned. Private lands occupy the moderately sloping benchlands and hillslopes and are used for haylands and pasture. Access to public lands along Tillinghast Creek is limited because much of the upper basin is under private ownership. Access to the lower portion is gained by USFS trail #322 leading from the Belt Park county road.

**GAME FISH PRESENT:** Brook trout, cutthroat trout, rainbow trout

**FISHERY:**

Brook trout are the most abundant game fish, followed by cutthroat and rainbow trout. Mottled sculpin are also common. A two-pass method (Leathe 1983) population estimate was made in a 450-foot section about 3 miles upstream from the mouth during September 1987. Standing crop estimates for brook, cutthroat and rainbow trout are given in Table 3-58. Total numbers were estimated at 956 trout/mile.

Table 3-58. Size statistics and standing crop estimates for fish populations in Tillinghast Creek, September 1987.\* (95% confidence intervals in parentheses.)

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range	No. / 1,000 ft.
Brook trout	46	6.1	(2.6-9.2)	0.10	(0.01-0.31)	109 (± 12)
Cutthroat trout	13	5.5	(1.9-7.8)	0.05	(0.01-0.16)	36 (± 22)
Rainbow trout	13	6.4	(2.3-8.7)	0.09	(0.02-0.23)	36 (± 22)

\* Fish less than 4 inches were excluded from estimate and average size analysis.

Tillinghast Creek has excellent trout habitat. Both instream and bank cover are abundant throughout its course. There is little evidence of siltation at this time. This stream receives light fishing pressure because of its remote location and somewhat restricted access.

**WILDLIFE:**

Big game species include black bear, mule deer and elk. Beaver is the only furbearer noted. Game birds include ruffed and blue grouse.

**WETTED PERIMETER:**

Cross-sectional data were collected in a 214-foot section about 1/4 mile below Thunder Creek (Sec. 9B, T15N, R7E). Five cross sections were established in 3 riffles. The WETP program was calibrated to field data collected at flows of 7.5, 19.1 and 73.5 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-51. An upper inflection point occurs at an approximate flow of 5.5 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations; to provide flows for Belt Creek; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1 - December 31 -- 5.5 cfs (3,982 A.F./yr.)

# TILLINGHAST CREEK

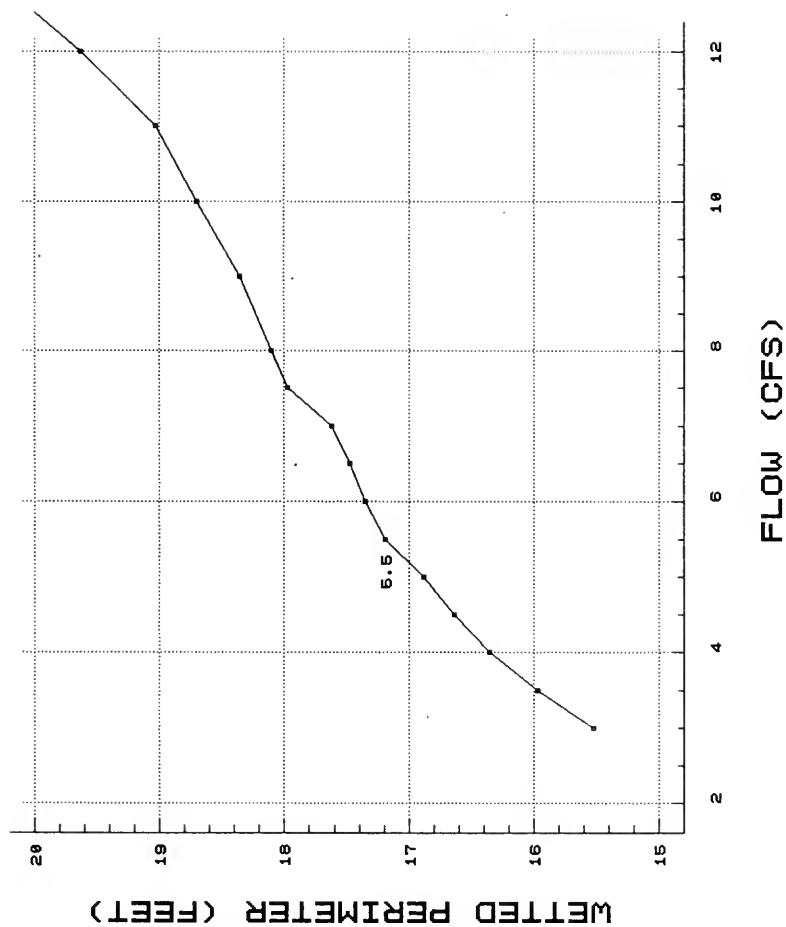


Figure 3-51. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Tillinghast Creek.

**STREAM NAME:** Pilgrim Creek

**STREAM REACH:** From its headwaters to its confluence with Belt Creek -- 11 miles

**LOCATION:** Sec. 12B, T14N, R6E to Sec. 26A, T16N, R6E

**DESCRIPTION OF STREAM REACH:**

Pilgrim Creek is located in Cascade County within the boundary of Lewis and Clark National Forest. It originates near Mount Pilgrim in the Little Belt Mountains at an elevation of 6,600 feet and flows south for 11 miles to its confluence with Belt Creek 5.5 miles downstream of Monarch (elevation 4,320 feet). Goblin and Circle gulches and Deer Creek are the primary tributaries to Pilgrim Creek. The landscape of the basin varies from moderate to steeply sloping limestone mountains which support a montane forest.

Pilgrim Creek flows through a moderately sloping valley in the upper section. Englemann spruce dominate the riparian zone along with isolated patches of willows. Downstream of Circle Gulch, and for the remaining 3 miles, the stream becomes entrenched within a steep, narrow limestone canyon. The riparian zone in this lower section is a mixed spruce and Douglas fir overstory with an undergrowth comprised of water birch and red osier dogwood. Pilgrim Creek is probably one of the steepest gradient fourth-order streams in the Little Belt Mountains with a grade of over 150 feet/mile. Channel substrates are indicative of a cascade-type stream. Boulders and large cobbles are a predominant substrate along with bedrock outcrops in the lower canyon. There is little evidence of siltation, probably a result of the pristine nature of this undisturbed basin.

Fishing, hunting and backpacking are popular recreational uses within this remote drainage. The U.S. Forest Service manages this basin for semi-primitive recreational opportunities. Access to the stream is basically confined to trails off USFS roads outside the basin. Forest Service trail #304 closely parallels Pilgrim Creek's entire course.

**GAME FISH PRESENT:** Westslope cutthroat trout

## FISHERY:

Pilgrim Creek is unique for the Little Belt Mountains because it provides favorable habitat for the environmentally sensitive westslope cutthroat trout. There are few cutthroat populations in this mountain range that are not mixed with other trout species. The absence of other salmonids is probably related to the steep gradient and associated water fall barriers. Genetic analyses indicate that this population has a high potential of being pure strain westslope cutthroat trout (Dr. Fred Allendorf, University of Montana, 1983, personal communication). The westslope cutthroat is listed as a "Species of Special Concern--Class B" because of species decline in distribution and abundance.

A 584-foot section located about 2 miles upstream from the mouth was sampled in September 1986. A two-pass method (Leathe 1983) standing crop estimate for the cutthroat population is given in Table 3-59. Total numbers were estimated to be 777 trout/mile. This is considered an abundant cutthroat population for smaller streams in this area.

Table 3-59. Size statistics and standing crop estimate for cutthroat trout in lower Pilgrim Creek, September 1986.\* (95% confidence intervals in parentheses).

	Number	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Cutthroat trout	86	5.6	(1.8-10.4)	0.09	(0.01-0.34)	147 ( $\pm 3$ )

\* Fish less than 4 inches were excluded from estimate and average size analyses.

Fishing pressure on Pilgrim Creek is generally light during most years.

## WILDLIFE:

Big game species found within the basin include black bear, mule deer and elk. Game birds include ruffed and blue grouse. Mink and beaver are common furbearers.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 145-foot section located about 2 miles upstream from the mouth (Sec. 34D, T16N, R6E). Five cross sections were established in two riffles. The WETP program was calibrated to field data collected at flows of 4.8, 12.9 and 33.5 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-52. Lower and upper inflection points occur at approximate flows of 3.5 and 8 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident population of westslope cutthroat trout, a "Species of Special Concern;" to provide flows for Belt Creek; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 8 cfs (5,792 A.F./yr.)



# PILGRIM CREEK

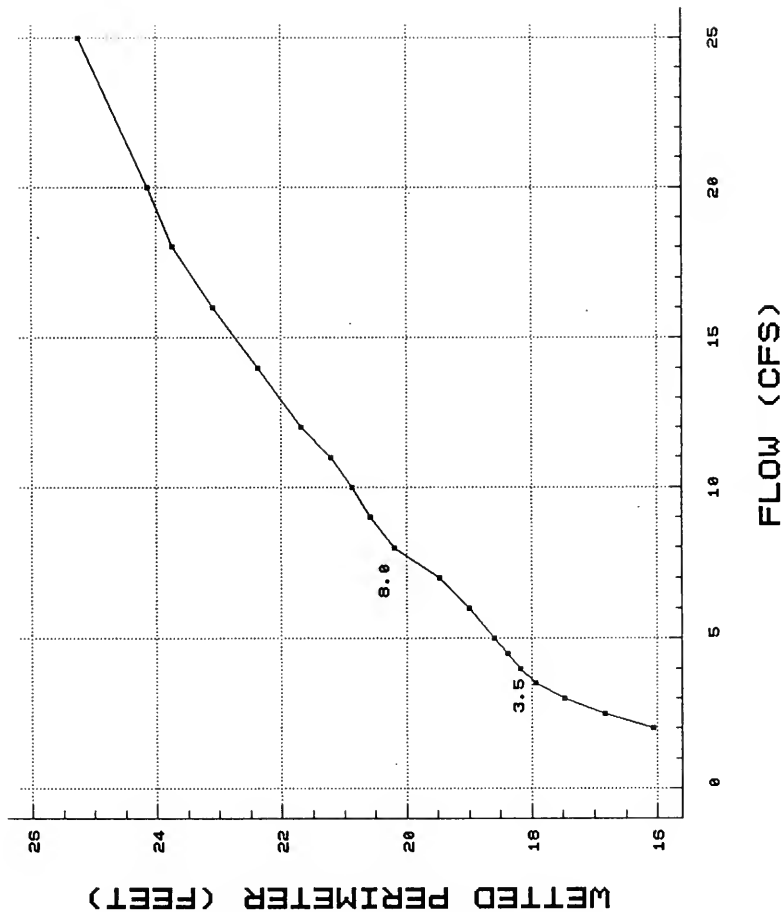


Figure 3-52. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Pilgrim Creek.

**STREAM NAME:** Logging Creek

**STREAM REACH:** From its headwaters to its confluence with Belt Creek -- 11 miles

**LOCATION:** Sec. 34D, T15N, R5E to Sec. 22D, T16N, R6E

**DESCRIPTION OF STREAM REACH:**

Logging Creek is located in Cascade County within the boundary of the Lewis and Clark National Forest. It originates near Monument Ridge in the northern end of the Little Belt Mountains at an elevation of 7,300 feet and flows northeast for 11 miles to its confluence with Belt Creek, 7.5 miles downstream from Monarch (elevation 4,260 feet). Major tributaries to Logging Creek include Big Timber and Sawmill gulches and Lick Creek. The landscape of the basin varies from moderate to steeply sloping limestone mountains which support a montane forest.

Logging Creek flows through a moderately wide canyon. The riparian consists of a variety of conifers dominated by spruce in the overstory with an undergrowth of willows, red osier dogwood and water birch. Logging Creek is a steep gradient stream with a grade of 113 feet/mile. Channel substrate is dominated by boulders and cobbles.

The U.S. Forest Service manages the lands within the basin for timber, livestock grazing and recreation. This area receives intensive use by outdoor recreationists because of a major Forest Service road which parallels the stream and the presence of a 30 unit campground along the creek. Fishing, hunting and camping are population recreational uses. The lower 3.5 miles of Logging Creek is privately owned by a rancher and several cabin owners.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout

**FISHERY:**

Brook trout are the most abundant game fish, followed by rainbow and brown trout. A two-pass method (Leathe 1983) population estimate was made in a 568-foot section near the Logging Creek Campground 3.5 miles above the mouth during October 1987. Standing crop estimates for brook and rainbow trout are given in Table 3-60. Total numbers were estimated at 1,183 trout/mile. This is considered an abundant fish population for smaller streams in this area.

Table 3-60. Size statistics and standing crop estimates for fish populations in Logging Creek, October 1987.\* (95% confidence intervals in parentheses.)

Species	Number Captured	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brook trout	98	5.9	(4.0-10.2)	0.10	(0.03-0.45)	176 (± 6)
Rainbow trout	26	5.9	(4.0- 9.3)	0.10	(0.02-0.35)	48 (± 5)

\* Fish less than 4 inches were excluded from estimate and average size analyses.

Logging Creek provides favorable habitat conditions for trout throughout most of its length. Fishing pressure is moderate, although there is considerable use in the section adjacent to the campground.

#### WILDLIFE:

Big game species found within the basin include black bear, elk, and mule deer. Game birds include ruffed and blue grouse. Mink and beaver are common furbearers.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 158-foot section located about 3.5 miles above the mouth (Sec. 31D, T16N, R6E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 5.2, 9.3 and 17.7 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-53. Lower and upper inflection points occur at approximate flows of 3.5 and 6 cfs, respectively.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the resident trout populations; to provide flows for Belt Creek; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### FLOW REQUEST:

January 1 - December 31 -- 6 cfs (4,344 A.F./yr.)

# LOGGING CREEK

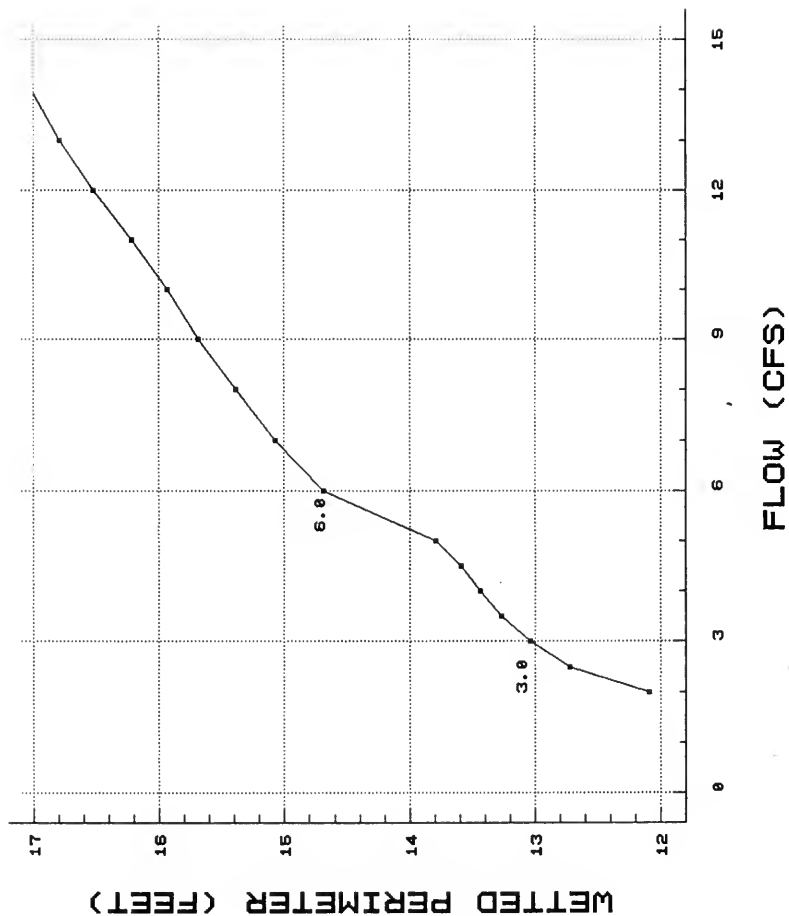


Figure 3-53. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Logging Creek.

**STREAM NAME:** Big Otter Creek

**STREAM REACH:** From its headwaters at Whiskey Spring Coulee (10 miles SE of Raynesford) to the confluence with Belt Creek -- 26.5 miles

**LOCATION:** Sec. 7A, T16N, R9E to Sec. 1D, T18N R6E

**DESCRIPTION OF STREAM REACH:**

Big Otter Creek is located in Judith Basin and Cascade counties. This stream originates in the foothills of the Little Belt Mountains at an elevation of about 5,000 feet and flows northwest merging with Belt Creek about 3 miles upstream from the town of Belt (elevation 3,600 feet). Williams, Little Otter and Cora creeks are the primary tributaries to Big Otter Creek.

Big Otter Creek is primarily a groundwater-fed prairie stream although it drains the sub-humid to semi-arid foothills. Underlying most of the basin are porous sandstones of the Kootenai formation, which is known for being one of the most important water-bearing formations in Central Montana (Perry 1932). The Kootenai formation in this region is also part of a large artesian aquifer. Big Otter Creek drains only part of this aquifer. The aquifer recharges in the upper foothills near the Little Belt Mountains and discharges via numerous springs located in outcrop areas (Perry 1932). In the basin, such small springs occur in several of the coulees draining into the creek (Zizz 1988. District Conservationist, SCS. Personal Communication to Bill Gardner, DFWP). Because of this artesian system, Big Otter Creek, unlike other prairie streams, is able to maintain a consistent perennial flow. Spring run-off is usually not excessive, as is characteristic of most mountain streams, because of the semi-arid climate and large water storage component of the basin.

The landscape of the basin consists of undulating prairie foothills which support mostly bunchgrass vegetation interspersed with pockets of brush. Big Otter Creek occupies an entrenched channel within a deeply cut and moderately narrow valley floor. From this valley and those of its tributaries, a series of deep lateral valleys have been cut headward, creating a series of deep coulees within the surrounding sandstones.

The riparian zone consists of willow dominated shrubby vegetation with a dense undergrowth of herbs and grasses. Hay meadows and pasture lands flank the stream in level areas above the floodplain. Within its valley, Big Otter Creek meanders extensively, moderating the stream gradient to 37 feet/mile. A railroad and highway closely parallel the stream course and have altered the channel throughout its length. This has caused substantial downcutting of the channel and excessive bank erosion. The cobble and boulder substrate has become silted as a result of this erosion.

The basin consists mostly of rangeland and supports numerous cattle ranches. The foothills provide good upland bird and mule deer hunting; however, access is limited because of private ownership. The creek is fairly accessible in many places along U.S. Highway 87 which parallels the stream course for about 17 miles. Access to the stream across private property is usually allowed with permission.

**GAME FISH PRESENT:** Brown trout, rainbow trout, and brook trout

#### **FISHERY:**

Brown trout are the predominant fish found throughout Big Otter Creek, followed by brook and rainbow trout. Non-game species include mottled sculpin, longnose dace, mountain, longnose and white suckers.

A 690-foot section located in the middle of the reach was sampled during September, 1987 using the two-pass method (Leathe 1983). Standing crop estimates for brown and brook trout populations are given in Table 3-61. Total trout numbers were estimated to be 372 fish/mile.

Table 3-61. Size statistics and standing crop estimates for fish populations in Big Otter Creek at MAFB Heliport, September 1987.\* (95% confidence intervals in parentheses.)

	Number	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brown trout	35	9.1	(4.0-18.9)	0.29	(0.01-1.99)	52 ( $\pm$ 4)
Brook trout	7	9.4	(7.9-12.5)	0.45	(0.18-0.48)	10 ( $\pm$ 1)

\* Fish less than 4 inches were excluded from estimate and average size analyses.

Even though the substrate is moderately silted and the stream banks actively eroding, Big Otter Creek has exceptionally high aquatic vegetation and insect productivity. There are a large number of big brown trout for a stream of this size. Dense bank vegetation, stable stream flows and excellent pool development accentuate trout habitat despite limiting factors which include channel alterations, stock trampling and elevated summer water temperatures. This stream receives a substantial amount of fishing pressure for its size.

#### WILDLIFE:

Big game inhabiting the basin include mule deer, white-tailed deer and antelope. Game birds include ring-necked pheasant, blue and sharp-tailed grouse and Hungarian partridge. Furbearers are beaver, mink and muskrat.

#### WETTED PERIMETER:

The wetted perimeter method was determined to be unsuitable for use on Big Otter Creek to assess instream flow needs. Although Big Otter Creek does sometimes experience heavy runoff, it has more characteristics of a spring creek. Flows are generally stable throughout the year. The riffles are narrow and not very extensive. For spring creeks the base flow is recommended as the instream flow. Periodic stream flow measurements were used to determine the base flow. These flows are listed in Table 3-62. The USGS estimated the base flow at 5 cfs (see Volume 1, Appendix A). From this information, it was determined that the base flow for Big Otter Creek is approximately 5 cfs.

Table 3-62. Stream flows measured by DFWP on Big Otter Creek during 1987 and 1988 at a station 9 miles upstream from the mouth.

	Date	Flow cfs)
1987	May 12	12
	June 3	15
	August 20	7
1988	May 12	15
	June 14	11
	September 15	5
	November 3	6

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to protect a spring-like aquatic system which is considered uncommon throughout Montana; to maintain the existing trout populations and assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 5 cfs (3,620 A.F./yr.)

Because of the spring-like characteristics of Big Otter Creek, the instream flow requested is the base flow as determined by DFWP and the USGS.



**STREAM NAME:** Highwood Creek

**STREAM REACH:** From the headwaters to Highway #228 Bridge at Highwood -- 24 miles

**LOCATION:** Sec. 9D, T19N, R9E to Sec. 14B, T12N, R7E

**DESCRIPTION OF STREAM REACH:**

Highwood Creek, located in Chouteau County, originates in the Highwood Mountains (elevation 5,600 feet) within the Lewis and Clark National Forest. It flows northwest from a forested, granitic mountain area through sedimentary prairie foothills and plains for approximately 40 miles to the confluence with the Missouri River (elevation 2,740 feet) 25 miles upstream of Fort Benton. Major tributaries entering this reach are Big Coulee and the North Fork of Highwood Creek.

The reach begins in a montane woodland and parkland area and flows through a 1/4-mile wide valley, bordered by willows and grasses. The lower half of the reach flows through prairie foothills with a deciduous woodland riparian comprised of a cottonwood overstory and a rose and snowberry understory. Gradient is 89 feet/mile. Channel substrate is chiefly small boulders and cobbles.

About 1/3 of the drainage is forested land managed by the U.S. Forest Service for livestock grazing and limited timber harvest. The rest is sparsely timbered and used as haylands and for grazing. Fishing, hunting and camping are the primary recreational uses.

The public has good access to this stream. Nearly half the reach is within the National Forest boundary and a road follows the main course of the creek. The lower portion also is bordered by a public road and access to the stream is generally granted with permission.

**GAME FISH PRESENT:** Brook trout, rainbow trout, cutthroat trout, brown trout

**FISHERY:**

Brook trout are the predominant fish found throughout this reach. Rainbow trout are common but less numerous. Cutthroat trout are confined to the headwater areas and brown trout have

only been noted in the lower portions of the reach. Nongame species include white and longnose suckers and mottled sculpin.

A 450-foot section located in the middle of the reach was sampled during the summer of 1986 using the two-pass method (Leathe 1983). Fishes observed include brook trout, rainbow trout and sculpin. Young-of-the-year fish of these species were noted. Standing crop estimates for brook and rainbow trout are given in Table 3-63. Total trout numbers were estimated to be 2,086 fish/mile. This is considered an exceptionally abundant fish population for a stream of this size and location.

Table 3-63. Size statistics and standing crop estimates for fish populations in the Elk Run section of Highwood Creek, September, 1986\*. (95% confidence intervals in parentheses).

No. Captured		<u>Length (in.)</u>		<u>Weight (lbs.)</u>		No./ 1,000 ft.
		Range	Average	Range	Average	
Brook trout	79	2.6-11.0	6.0	0.01-0.48	.09	231 ( $\pm$ 73)
Rainbow trout	61	2.5-12.0	7.2	0.01-0.60	.13	164 ( $\pm$ 42)

\* Fish less than 4 inches were excluded from estimate and average size analysis.

The upper 16 miles of Highwood Creek have excellent habitat conditions and have recovered remarkably from the severe channel dredging which occurred during the early 1960s. Chronic low stream flows and siltation problems limit the trout fishery in the lower 4 miles of this reach. This productive stream is one of the two main trout streams found in Chouteau County, and it receives a substantial amount of angler use. The statewide fishing pressure and harvest survey for 1982-86 reports an average of about 1,200 angler-days of use per year (McFarland 1989).

#### WILDLIFE:

Big game inhabiting this reach of Highwood Creek are elk, mule deer and white-tailed deer. Game birds include ring-necked pheasant, ruffed, blue and sharp-tailed grouse. Furbearers are mink, beaver and muskrat.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 220-foot section located about 3 miles downstream from the Forest Service boundary (Sec. 14D, T20N, R8E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 2.9, 13.3 and 30.2 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-54. Lower and upper inflection points occur at approximate flows of 4 and 10 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain trout populations in their existing condition, especially considering the local value of the few trout streams found in this large, semi-arid county; and to assist in the maintenance of habitat for those wildlife species which depend upon the stream and riparian zone for their food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 10 cfs (7,240 A.F./yr.)

# HIGHWOOD CREEK

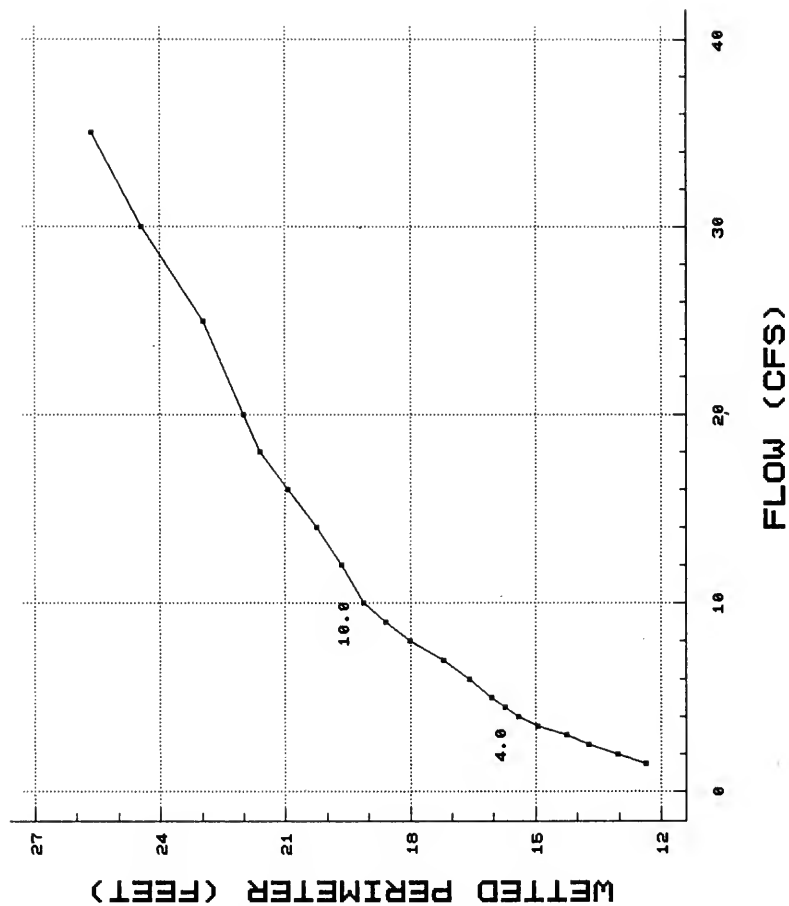


Figure 3-54. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Highwood Creek.

**STREAM NAME:** Shonkin Creek

**STREAM REACH:** From forest boundary to the town of Shonkin --  
12 miles

**LOCATION:** Sec. 12D, T20N, R9E to Sec. 28D, T22N, R9E

**DESCRIPTION OF STREAM REACH:**

Shonkin Creek, located in Chouteau County, originates in the Highwood Mountains (elevation 5,100 feet) within the Lewis and Clark National Forest. It flows northerly from a moderately forested, granitic mountain area through sedimentary prairie foothills and plains for approximately 50 miles to the confluence with the Missouri River (elevation 2,600 feet) 5 miles downstream from Fort Benton. Major tributaries are Kirby, Postill and Bishop creeks.

Several small tributaries enter Shonkin Creek just north of the national forest boundary. The stream flows through aspen parklands and deciduous woodlands amid a narrow U-shaped valley of volcanic bedrock, then turns northwest, entering a prairie benchland where it becomes deeply entrenched within sedimentary bedrock. From this steep canyon, the lower portion enters the wide and gently sloping Shonkin Sag, where the creek begins on a meandering course through willow brushlands and prairie grasslands.

The riparian zone in the upper portion is a narrow, mixed deciduous woodland with an eastern cottonwood canopy and a dense shrubby undergrowth of willows, rose and snowberry. The riparian zone along the lower section consists of dense willows surrounded by grasslands and hay meadows.

Stream gradient, although decreasing dramatically within the Shonkin Sag, is about 88 feet/mile in the upper reach where the cross sections were established. Channel substrate is comprised of boulders and cobbles.

Throughout the basin, livestock grazing and hay production are common agricultural land uses, while big game hunting and fishing are the primary recreational uses. Overgrazing near the headwaters of Shonkin Creek has reduced riparian vegetation and stream bank stability.

Public access is unlimited in the upper headwaters. A public road parallels the upper 2/3 of the reach, providing stream access above the canyon. Access to private lands is generally granted with permission.

**GAME FISH PRESENT:** Brook trout, rainbow trout

**FISHERY:**

Brook trout are the most abundant game fish found throughout the reach; rainbow trout are rare. Non-game fish include longnose and white suckers and mottled sculpin. A 472-foot section located on private land near the middle of the reach was sampled during the summer of 1986 using the two-pass method (Leathe 1983). Brook trout, both young-of-the-year and adults, was the only species collected. A standing crop estimate is given in Table 3-64. Total trout numbers were estimated to be 1,890 fish/mile. This is considered an especially abundant fish population for streams in this area.

Table 3-64. Size statistics and standing crop estimates of brook trout in the Robertson section of Shonkin Creek, September, 1986.\* (95% confidence intervals in parentheses.)

	Number	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brook trout	160	5.9	(2.4-10.5)	0.09	(0.01-0.55)	358 ( $\pm$ 22)

\* Fish less than 4 inches were excluded from estimate and average size analysis.

Although this fast flowing stream provides few deep pools, dense bank vegetation and a favorable substrate of boulders and cobbles provide the resident trout with good habitat and an ample food supply. Beaver dams provide shelter during both high and low flow periods.

This productive creek is one of only two principal trout streams found in Chouteau County and receives a fair amount of angler use, mostly by local residents.

#### **WILDLIFE:**

Big game inhabiting this reach of Shonkin Creek are elk, mule deer and white-tailed deer. Game birds include ring-necked pheasant and ruffed, blue and sharp-tailed grouse. Waterfowl use the many beaver ponds, some of the more common species being mallards and common mergansers. Furbearers include beaver, mink and muskrat.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 97-foot section located about 1/4 mile upstream from Bishop Creek (Sec. 26D, T21N, R9E). Five cross sections were established in 3 riffles. The WETP program was calibrated to field data collected at flows of 2.4, 6.1 and 11.6 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-55. Lower and upper inflection points occur at approximate flows of 2.3 and 7.0 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the quality of the existing fishery and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 7 cfs (5,068 A.F./yr.)

# SHONKIN CREEK

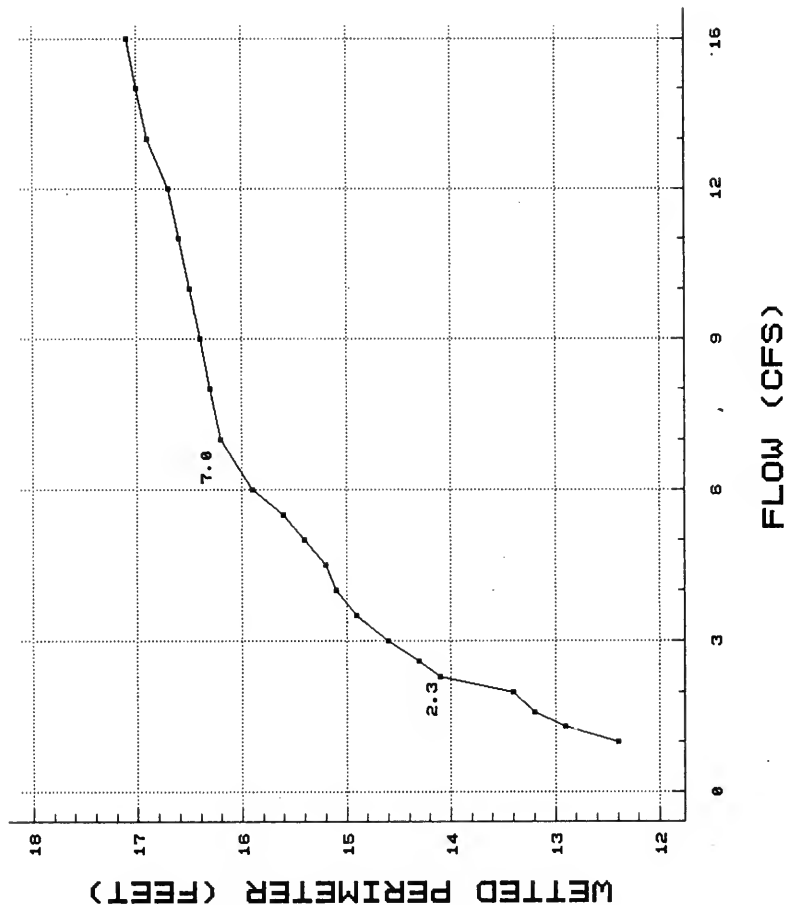


Figure 3-55. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Shonkin Creek.



## Marias River Drainage

Figure 3-56 is a map which shows the location of the following streams discussed in this section:

Marias River	South Badger Creek
Birch Creek	North Badger Creek
South Fork Dupuyer	Badger Creek
North Fork Dupuyer	So. Fork Two Medicine River
Dupuyer Creek	Cut Bank Creek

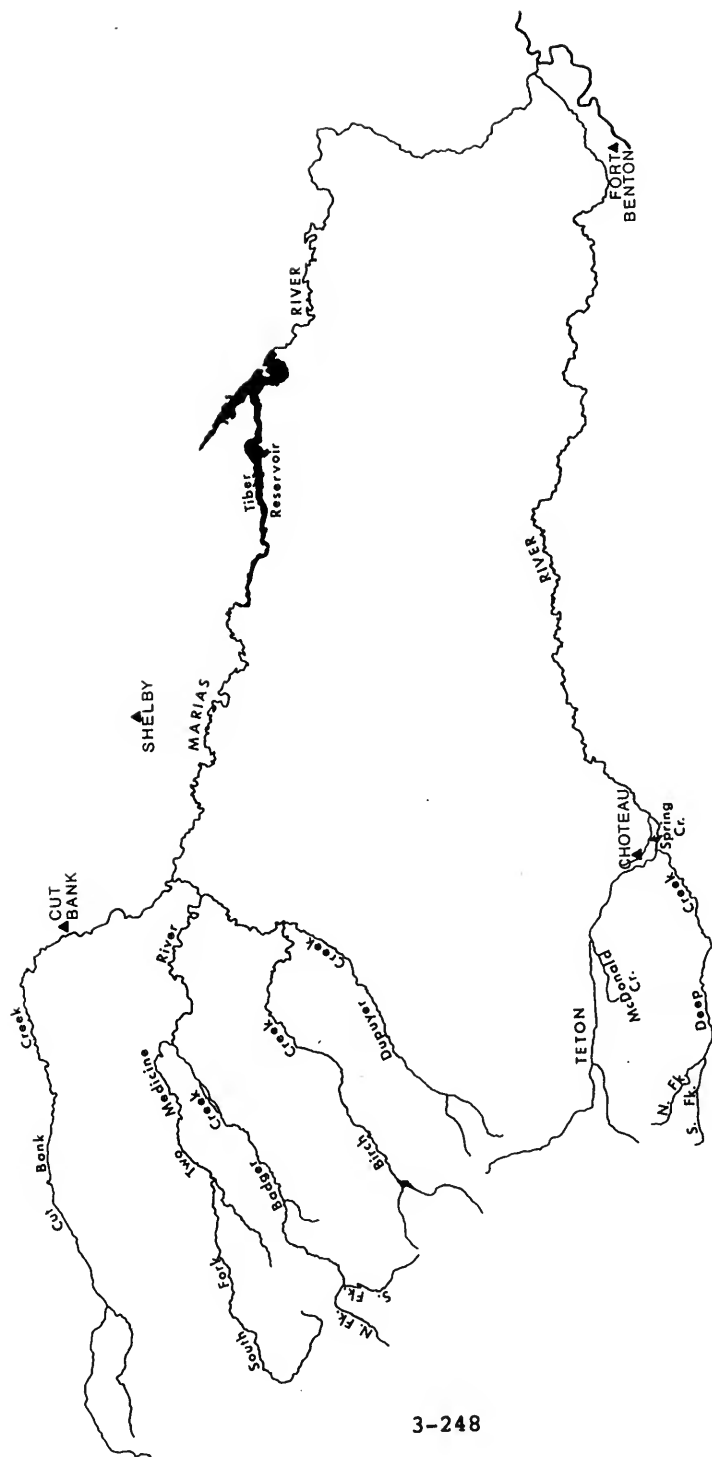


Figure 3-56. Location map for the Marias River Drainage.

**STREAM NAME:** Marias River

**DESCRIPTION OF THE BASIN:**

The Marias River is the largest tributary of the Missouri River between Canyon Ferry and Fort Peck dams. This north-central prairie stream drains about 9,100 square miles of the Rocky Mountain Front and Lewis Mountain ranges. The Marias begins 12 miles north of Valier (elevation 3,280 feet) and flows 170 miles east and south to its confluence with the Missouri River near Loma (elevation 2,550 feet). Major tributaries include the Two Medicine River, Cutbank, Badger, and Birch creeks. The Teton River joins the Marias about 1 mile upstream from the Marias River's mouth. The Teton River subbasin has been discussed in another section.

Long-term USGS flow records are available for the Marias River near Shelby (river mile 140.6) and below Tiber Dam near Chester (river mile 78.3). The mean annual flow near Shelby for an interrupted 79-year period of record between 1902-87 was 926 cfs, with a low of 10 cfs and a high of 75,700 cfs. The mean annual flow below Tiber Dam for a 34-year interrupted period of record between 1945-87 was 852 cfs. Extreme flows since Tiber Dam was completed in 1955 have ranged from a low of nearly zero to a high of 10,400 cfs. A shorter period of record (13 years) for the Marias River near the mouth at Loma between 1959-72 showed a mean annual flow of 977 cfs, with a low of 45 cfs and a high of 10,800 cfs.

The upper Marias River basin is situated in the mountainous area of the Lewis and Clark National Forest and Glacier National Park. Its upper tributaries originate at an elevation of about 10,000 feet and flow out onto the prairie. There is little development in the foothill transition zone between the mountains and prairie. The Marias originates at the confluence of the Two Medicine River and Cutbank Creek about 35 miles east of the mountain zone. The upper main stem includes Reach #1 and flows for 60 miles before discharging into Tiber Reservoir. Within this reach, the Marias flows through a rolling prairie landscape while entrenched in a well-defined valley about 1 mile wide. Soft shale and sandstone bluffs flank the river, rising 200 to 400 feet above the valley floor. The riparian vegetation consists of a deciduous woodland dominated by an overstory of cottonwoods and an undergrowth of willows, rose, and buffalo berry. The overall stream gradient is 5 feet/mile and varies from 11 feet/mile in the upper portion to less than 2 feet/mile in the lower end of the reach. Channel substrate is mostly comprised of cobbles and gravel with moderate amounts of siltation.

The lower Marias main stem includes Reaches #2 and #3. It begins at Tiber Dam and flows for 78 miles to its confluence with the Missouri River. It lies in the semi-arid prairie lands at elevations between 3,000 and 4,000 feet. This area is moderately dissected with drainages that collect lowland runoff chiefly during March through June. With the exception of the Teton River, there are no perennial tributary streams joining the Marias.

Present day flow regimens of the lower Marias River are completely regulated by the flood control operations of Tiber Reservoir. Tiber Dam was completed in 1955 and is operated by the U.S. Bureau of Reclamation. This reservoir stores the high spring runoff and augments base flows of the lower river.

Water temperatures downstream of Tiber are also affected by the operation of the dam. Stober (1962) reported that deep cold water releases from the reservoir significantly reduced the river's summer temperatures at least 20 miles below the dam.

Throughout its entire course, the lower Marias is entrenched in a well-defined river valley. The valley is about 3/4 mile wide at the upper and lower ends, and narrows in the middle to form a scenic canyon less than 400 yards wide. Shale and sandstone bluffs border the river and rise 200 to 400 feet above the narrow floodplain.

The riparian vegetation is dominated by older cottonwood trees with a moderate undergrowth of rose and buffalo berry. Islands and lower floodplain areas support stands of willow. The floodplain throughout the lower river is in a static condition because of the regulated flows and the absence of regular flooding events. This has limited the abundance of early-aged cottonwood stands and other riparian vegetation dependent on flooding.

The overall stream gradient is 3.5 feet/mile and varies only slightly from 3.0-4.5 feet/mile. Channel substrate is mostly comprised of cobbles and gravel. Siltation increases in a downstream progression from Tiber Dam.

Land uses in the Marias River drainage are fairly diverse. In the forested areas of the upper basin, a considerable portion is in designated wilderness that includes the Bob Marshall Wilderness Area and Glacier National Park. Forest Service lands outside the Bob Marshall Wilderness Area are managed for semi-primitive recreation and other multiple uses, including oil and gas exploration, livestock grazing, and

minor amounts of timber harvest. Grain and hay production and livestock grazing are principal uses which occur in the prairie lands of the upper and lower basins. Most of the land in this area is privately owned. There are a few scattered parcels of federal land managed by either the Bureau of Land Management or Bureau of Reclamation. These lands are primarily located along the perimeter of Tiber Reservoir and areas adjacent to the lower Marias River. The river and surrounding lands are important recreation areas. Fishing, hunting, picnicking, and floating are popular activities associated with the river environment.

The largest user of water in the Marias Basin is irrigated agriculture. Table 3-65 lists water consumption for each subbasin during 1980, and gives a representation of the annual use. A total of 206,696 acre-feet or 34% of the average annual flow was consumed during this fairly typical year (Montana Department of Natural Resources and Conservation 1986). Including Tiber, four other reservoirs in the basin have storage capacities greater than 1,000 acre-feet. All except Tiber are used primarily for irrigation. These reservoirs have an estimated total storage capacity of 1,542,158 acre-feet.

Access to the 138 miles of river is generally limited to seven bridge crossings and about 2 miles of public river frontage, one immediately upstream from Tiber Reservoir and the other downstream from the dam. Although the river is usually navigable, the distances between bridges in the upper river and most portions of the lower river generally require more than a day's travel. Most of the private landowners allow access with permission; however, the terrain bordering the river is fairly rugged and physical access can be difficult.

Table 3-65. Water Consumption in the Marias Basin during 1980.

Use	Surface water withdrawn (acre-feet)	Surface water consumed (acre-feet)
Irrigation		
Cutbank Creek Drainage	78,002	14,512
Irrigation		
Two Medicine River Drainage	146,039	33,640
Irrigation		
Marias River Drainage	324,125	83,144
Municipal		
Marias Basin	--	1,400 <sup>1</sup>
Evaporation Loss		
Tiber Reservoir		
(estimate)	--	50,000 <sup>2</sup>
Evaporation Losses		
Other Basin Reservoirs		
(estimate)	--	<u>24,000</u> <sup>2</sup>
	Total	206,696

Source: Department of Natural Resources and Conservation 1986.

<sup>1</sup> Includes groundwater sources.

<sup>2</sup> Estimated from figures presented in this report.

**STREAM NAME:** Marias River

**STREAM REACH:** #1. From the confluence of the Two Medicine River and Cutbank Creek to the head of Tiber Reservoir - 60 miles

**LOCATION:** Sec. 35C, T32N, R5W to Sec. 13C, T30N, R1E

**GAME FISH PRESENT:** Walleye, mountain whitefish, rainbow trout, burbot, northern pike, channel catfish

**FISHERY:**

This reach of the Marias River is primarily a warmwater fishery where walleye are the most abundant game fish. Coldwater game fish, including rainbow trout and mountain whitefish, also inhabit this reach, but in lower numbers. Table 3-66 presents game fish survey information collected between 1984 and 1987.

Table 3-66. Summary statistics of game fish populations sampled by electrofishing and gill netting in the upper Marias River, 1984, 1986 and 1987.

Species	Number Captured	Average Length (in.)	Range	Average Weight (lb.)	Range
Walleye	400	15.7	(5.8-28.0)	1.39	(0.15-8.0)
Mountain whitefish	35	10.8	(5.8-17.0)	0.58	(0.18-1.86)
Rainbow trout	29	17.1	(5.4-22.0)	1.91	(0.10-3.90)
Burbot	7	10.2	(6.0-15.9)	0.33	(0.04-1.10)
Northern pike	5	23.3	(19.3-33.0)	--	(2.30-10+)
Channel catfish	1	19.1	--	2.60	

The average size of walleye is fairly large for a river population. Walleye use the upper Marias for spawning and a segment of the population remains in the river throughout the summer. Young-of-the-year walleye have been sampled during the summer, indicating that the river also provides rearing habitat. The average size for rainbow trout is large, averaging nearly 2 pounds. These large trout are found in the river mainly in the spring and early summer, preferring Tiber Reservoir during the rest of the year.

Eleven non-game fish species have been sampled in the upper Marias River. A tabulation of these species and their relative abundance is given in Table 3-67.

Table 3-67. Non-game fish sampled in the upper Marias River and their relative abundance.

Species	Abundance
Common carp	C
Flathead chub	A
Lake chub	R
Emerald shiner	C
Flathead minnow	U
Longnose dace	A
Mountain sucker	C
White sucker	C
Longnose sucker	A
Yellow perch	C
Mottled sculpin	C

A - abundant; C - common; U - uncommon; R - rare

Presently, the upper Marias River has only a moderate fishery. Surveys indicate there is ample forage and shelter habitat for other game fish species. The Department plans to introduce sauger and/or smallmouth bass into the system in the near future.

The upper Marias River receives only light fishing pressure. This is most likely due to its remote and fairly inaccessible location.

#### WILDLIFE:

Big game species found within the study reach include elk, mule and white-tailed deer. Game birds present are sharp-tailed grouse and ring-necked pheasant. Beaver, river otter, mink, muskrat, and raccoon are the furbearers found associated with the river habitat. Several species of waterfowl and shorebirds are attracted to the upper Marias during their migration period and throughout the ice-free period. The river throughout its course is especially important for Canada goose nesting and great blue heron rookeries.



#### **WETTED PERIMETER:**

Cross-sectional data were collected at four locations throughout the reach (Sec. 7C, T31N, R4W; Sec. 21D, T31N, R2W; Sec. 35A, T31N, R2W; Sec. 1A, T30N, R2W). Seven cross sections were located in 4 riffles. The WETP program was calibrated to field data collected at flows of 171, 464, and 1,270 cfs.

The relationship between wetted perimeter and flow from a composite of seven riffle cross sections is shown in Figure 3-57. An upper inflection point occurs at an approximate flow of 200 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident game fish populations; to maintain spawning and rearing habitats for migratory game fish from Tiber Reservoir; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water, and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 200 cfs (144,793 A.F./yr.)

# MARIAS RIVER (reach 1)

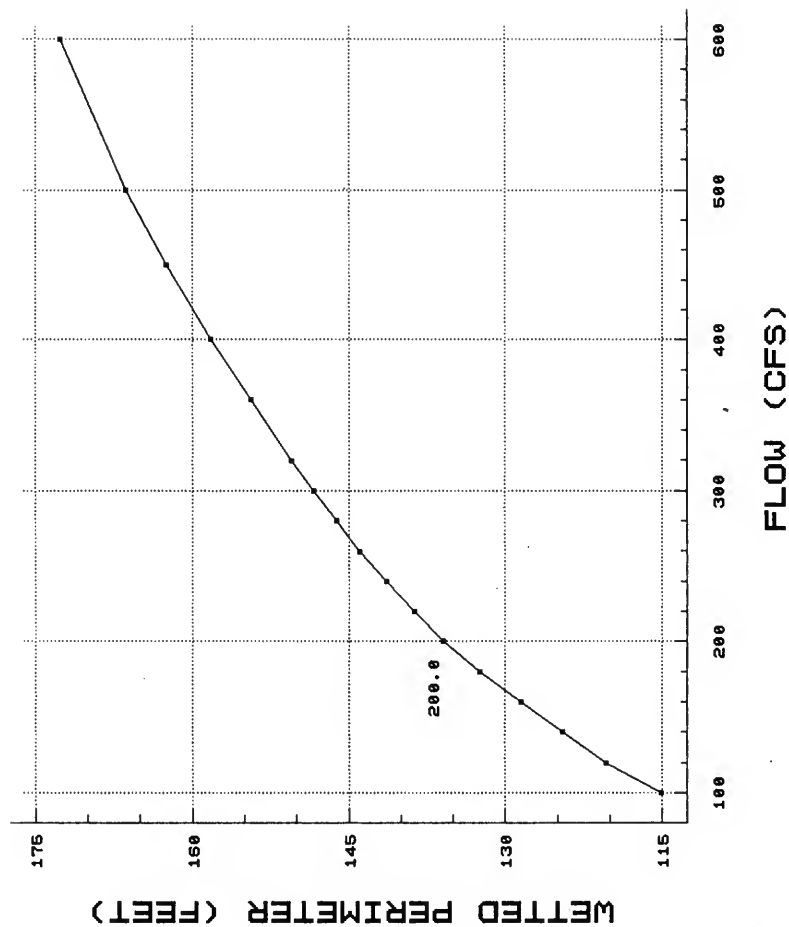


Figure 3-57. The relationship between wetted perimeter and flow for a composite of seven rifle cross sections in Reach 1 of the Marias River.

STREAM NAME: Marias River

STREAM REACH: #2. From Tiber Dam to Circle Bridge (Highway #223)  
-- 21 miles

LOCATION: Sec. 33D, T30N, R5E to Sec. 24A, T29N, R6E

GAME FISH PRESENT: Mountain whitefish, rainbow trout, brown trout,  
sauger, walleye, northern pike, burbot

FISHERY:

Coldwater releases from Tiber Dam have altered the aquatic environment in this reach to favor salmonid species. Mountain whitefish exist in high numbers and are the most abundant game fish in the reach. Rainbow and brown trout occur in fair numbers, exhibiting excellent growth rates and attaining exceptionally large sizes. Warmwater game fish, including sauger, walleye, northern pike, and burbot also inhabit this reach, but in lower numbers. Table 3-68 presents game fish population estimates and survey information collected between 1982 and 1988.

Table 3-68. Standing crop estimates and size statistics of game fish populations sampled by electrofishing in the Marias River downstream of Tiber Dam, 1982-88.

Species	No.	Average Length (in.)	Range	Average Weight (lb.)	Range	No. /mile
Mountain whitefish	3001	14.3	( 4.0-21.7)	1.03	(0.07- 4.05)	1,780 <sup>1</sup>
Rainbow trout	423	12.1	( 3.1-21.6)	0.85	(0.02- 5.44)	81 <sup>2</sup>
Brown trout	248	15.2	( 3.1-32.0)	1.62	(0.04-13.0)	42 <sup>2</sup>
Sauger	99 <sup>3</sup>	15.3	(10.3-22.2)	0.99	(0.29- 3.19)	--
Walleye	65 <sup>3</sup>	14.3	( 8.0-22.8)	0.99	(0.13- 4.31)	--
Northern pike	47 <sup>3</sup>	26.6	(12.2-47.2)	--	(0.37- 9.0+)	--
Burbot	36 <sup>3</sup>	18.1	(10.6-32.3)	1.47	(0.26- 8.0)	--

<sup>1</sup> Estimate made in 1982 in a 2.7-mile section. Includes only fish age II and older.

<sup>2</sup> Average of two estimates made in 1987 and 1988 in a 4-mile section. Includes only fish 6.0 inches and larger.

<sup>3</sup> Total catch from four survey runs in 1982 covering the entire 21-mile reach.

Fourteen non-game fish have been sampled in Reach #2. A tabulation of these species and their relative abundance is given in Table 3-69.

Table 3-69. Resident non-game species sampled in the Marias River downstream of Tiber Dam and their relative abundance.

Species	Abundance
Goldeye	C
Common carp	C
Flathead chub	C
Lake chub	R
Emerald shiner	U
Western silvery minnow	U
Fathead minnow	U
Longnose dace	A
River carpsucker	C
Shorthead redhorse	C
Longnose sucker	A
White sucker	C
Yellow perch	C
Mottled sculpin	C

A - abundant; C - common; U - uncommon; R - rare

Reach #2 of the Marias River currently has a good fishery. Continual improvements in the trout fishery are anticipated because of improved cooperation with the Bureau of Reclamation concerning minimum instream flows and coldwater releases. This tailwater fishery is the only trout stream within a 50-mile radius and it receives a moderate amount of angler use.

#### WILDLIFE:

Big game species found within this study reach include mule and white-tailed deer. Game birds present are sharp-tailed grouse and ring-necked pheasant. Beaver, mink, muskrat, and raccoon are the furbearers associated with the river habitat. Several species of waterfowl and shorebirds are attracted to the Marias in this reach during their migration period and throughout the ice-free period. This segment of river is especially important for Canada goose nesting.

**WETTED PERIMETER:**

Cross-sectional data were collected at seven locations throughout the 21-mile reach. Eleven cross sections were located in seven riffles. The WETP program was calibrated to field data collected at flows of 209, 534 and 1,183 cfs.

The relationship between wetted perimeter and flow from a composite of 11 cross sections is shown in Figure 3-58. An upper inflection point occurs at an approximate flow of 500 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain and help improve the existing resident game fish populations; provide flows for the Missouri River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water, and shelter, including nesting Canada geese.

**FLOW REQUEST:**

January 1-December 31 -- 500 cfs (361,983 A.F./yr.)

# MARIAS RIVER (reach 2)

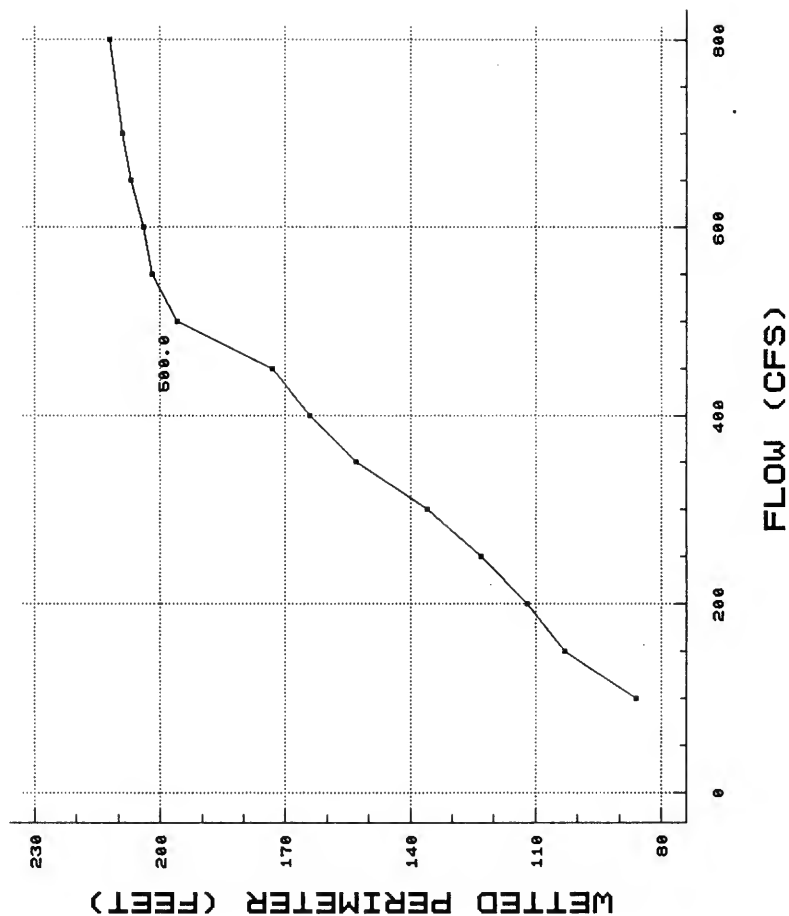


Figure 3-58. The relationship between wetted perimeter and flow for a composite of eleven riffle cross sections in Reach 2 of the Marias River.

**STREAM NAME:** Marias River

**STREAM REACH:** #3. From Circle Bridge (Highway #223) to mouth -- 57 miles

**LOCATION:** Sec. 24A, T29N, R6E to Sec. 18B, T25N, R10E

**GAME FISH PRESENT:** Sauger, mountain whitefish, shovelnose sturgeon, walleye, channel catfish, burbot, brown trout

**FISHERY:**

This reach of the Marias River contains a warmwater fishery in which sauger are the most abundant resident game fish. Walleye occur in fair numbers and are more numerous in the lower portion of the reach. Channel catfish are found in moderate numbers throughout the lower Marias. Game fish which migrate from the Missouri River into the Marias to spawn are shovelnose sturgeon, sauger, walleye, and channel catfish. Shovelnose sturgeon have been sampled throughout this reach during their spawning period, late-May through June. A moderate population of mountain whitefish and an occasional brown trout are the coldwater game fish found throughout the lower river.

Table 3-70 presents the size statistics for the game fish populations found in the lower Marias River.

Table 3-70. Size statistics of game fish populations sampled by electrofishing in the lower Marias River, Reach #3, 1979 and 1987-88.

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range
Sauger	228	13.5	(5.5-22.0)	0.72	(0.04-2.71)
Mountain whitefish	85	11.1	(3.9-16.5)	0.60	(0.04-1.83)
Shovelnose sturgeon	83	34.3	(29.6-43.0)	6.52	(4.00-15.3)
Walleye	62	14.5	(6.8-28.2)	1.13	(0.08-8.00)
Channel catfish	28	16.6	(11.5-31.0)	3.06	(0.48-14.8)
Burbot	2	--	(12.6-18.1)	--	(0.37-1.17)
Brown trout	4	13.5	(11.0-15.7)	1.11	(0.68-1.58)

Sizes of sauger and walleye are about average for Montana river populations. The sizes reported for shovelnose sturgeon are for only the adult spawning segment, however, the maximum sizes found here surpass most other records and underscore the value of this high quality population.

Sixteen resident non-game fish have been sampled in the lower Marias River. A list of these fish and their relative abundance is given in Table 3-71. Blue sucker, smallmouth buffalo, bigmouth buffalo, and freshwater drum are the migratory species found in the river during their spawning seasons, but they reside in the Missouri River during the rest of the year.

Table 3-71. Resident non-game species sampled in the lower Marias River, Reach #3 and their relative abundance.

Species	Abundance
Goldeye	A
Common carp	C
Flathead chub	A
Lake chub	U
Emerald shiner	C
Plains minnow	U
Western silvery minnow	C
Flathead minnow	U
Longnose dace	A
River carpsucker	C
Shorthead redhorse	C
Longnose sucker	A
White sucker	C
Mountain sucker	U
Stonecat	C
Mottled sculpin	R

A - abundant; C - common; U - uncommon; R - rare

This reach of the Marias, mostly the lower 6 miles, receives intensive angling pressure during the spring spawning season (April through mid-July). During the rest of the season, there is a moderate amount of angler use.

#### WILDLIFE:

Big game species found within this study reach include mule and white-tailed deer. Game birds present are sharp-tailed grouse and ring-necked pheasant. Beaver, mink, muskrat, and raccoon are the furbearers associated with the river habitat.



Several species of waterfowl and shorebirds are attracted to the Marias in this lower reach during their migration period and throughout the ice-free period. This segment of river is especially important for Canada goose nesting.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 1-mile section located about 5 miles upstream from the mouth (Sec. 9A, T25N, R9E). Four cross sections were located in two riffles. The WETP program was calibrated to field data collected at flows of 504, 705, and 1,036 cfs.

The relationship between wetted perimeter and flow from a composite of four riffle cross sections is shown in Figure 3-59. Lower and upper inflection points occur at approximate flows of 320 and 560 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain resident game fish populations; to help assure stream flows in the lower Marias River for spawning migrations of sauger, shovelnose sturgeon, walleye, channel catfish, and several non-game species originating from the Missouri River; provide flows for the Missouri River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water, and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 560 cfs (405,421 A.F./yr.)

# MARIAS RIVER (reach 3)

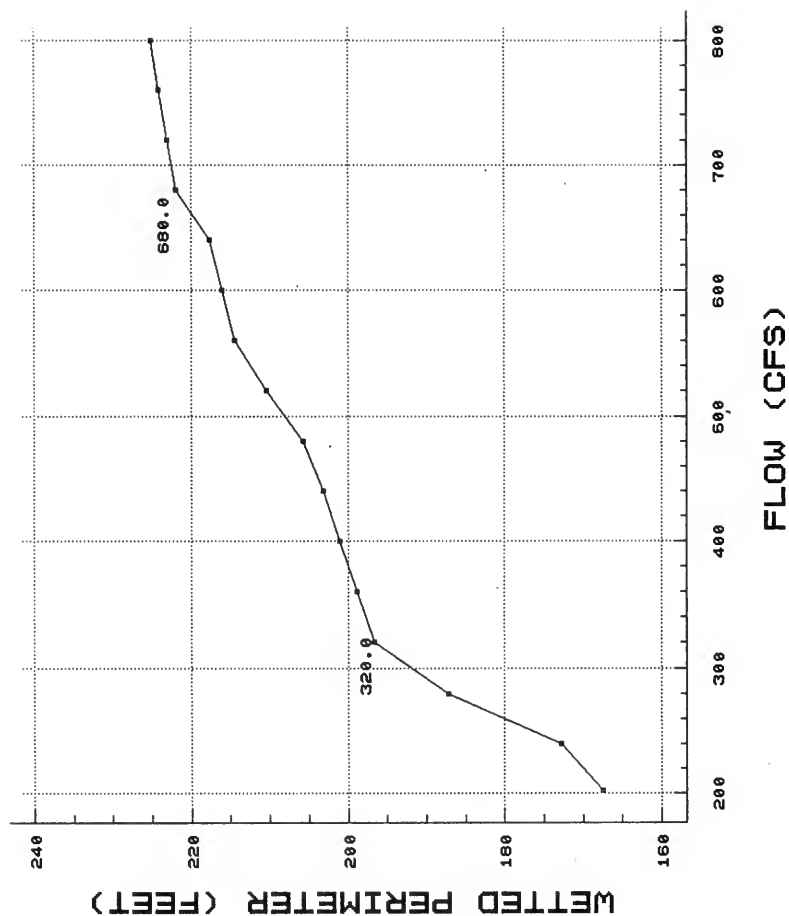


Figure 3-59. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Reach 3 of the Marias River.

**STREAM NAME:** Birch Creek

**STREAM REACH:** From Swift Reservoir to Highway 358 -- 43 miles

**LOCATION:** Sec. 23C, T28N, R10W to Sec. 14D, T30N, R6W

**DESCRIPTION OF STREAM REACH:**

Birch Creek is formed at the junction of its North and South forks. A portion of the forks and a short stretch of Birch Creek are inundated by a dam which creates Swift Reservoir. Major tributaries include Blacktail and Dupuyer creeks. Swift Dam is located at the mouth of a canyon adjacent to the east front of the Rocky Mountains. Swift Dam broke during the 1964 flood and destroyed personal property, human lives, and the habitat of Birch Creek. Birch Creek below the dam is characterized by a broad valley strewn with large boulders. Further downstream, the stream narrows but the substrate still contains large amounts of rocks and gravel. Stream gradient averages about 30 feet/mile throughout the reach. Water clarity is good.

Floods in 1964 and 1975 severely damaged riparian areas. The middle and lower reaches have somewhat recovered. Willows provide the main cover. Birch Creek is the southern boundary of the Blackfeet Indian Reservation. Land ownership south of the reservation is approximately 75% private and 25% equally divided between state and federal. Land use beyond the riparian area is hayland and pasture. One large diversion structure (550 cfs capacity) diverts water into Lake Frances via Dupuyer Creek. Several smaller diversions are also found within the reach.

USGS gauge records are available for Birch Creek (1) below Swift Dam, (2) near Dupuyer, and (3) near Valier. The mean annual flow below Swift Dam for a 16-year period of record (1913-29) was 148 cfs. The mean annual flow near Dupuyer for a 30-year period of record (1907-37) was 159 cfs. The mean annual flow for a 7-year period (1977-83) near Valier was 85 cfs.

**GAME FISH PRESENT:** Brook trout, rainbow trout, mountain whitefish

#### **FISHERY:**

Brook trout are fairly common in the upper portions of the reach along with a few rainbow trout. The lower reach has a few rainbow trout and mountain whitefish and fewer brook trout. Forage fish include longnose dace and mottled sculpin.

#### **WILDLIFE:**

Big game animals found in the area include elk and bighorn sheep (near Swift Dam), mule deer, white-tailed deer and black bear. The grizzly bear, a threatened species, uses the upper portion of the stream corridor during spring, summer, and fall. Upland birds include ruffed grouse, ring-necked pheasant, Hungarian partridge, and sharp-tailed grouse. Various furbearers and raptors also occur.

#### **WETTED PERIMETER:**

Birch Creek is a boundary stream of the Blackfeet Indian Reservation and DFWP did not conduct wetted perimeter studies on the stream. Instead, the requested flow was determined by the fixed percentage method described in Volume 1.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain spawning and rearing habitat for the existing trout fishery. The flow will also assist in maintenance of habitat for wildlife species that depend upon the stream for food, water, and shelter. The grizzly bear, a threatened species under federal law, is particularly dependent upon the stream and the adjacent areas.

#### **FLOW REQUEST:**

January 1-December 31 -- 64 cfs (46,334 A.F./yr.)

A flow recommendation derived from the wetted perimeter method is unavailable for Birch Creek. The instream flow request is, therefore, based on the fixed percentage method described in Volume 1. Under this method, 40% of the average annual flow is being requested for those Marias River tributaries having high fishery values. An average annual flow of 159 cfs was recorded by the USGS at gauge #06095000 (the gauge closest to the end of the stream reach with 10 or more years of record) for the period of record 1907-1937. An instream flow of 64 cfs is, therefore, requested.

**STREAM NAME:** South Fork Dupuyer Creek

**STREAM REACH:** From the headwaters to the mouth -- 6 miles

**LOCATION:** Sec. 3C, T26N, R9W, to Sec. 18C, T27N, R8W

**DESCRIPTION OF STREAM REACH:**

The South Fork Dupuyer Creek begins within the Lewis and Clark National Forest approximately 16 miles southwest of Dupuyer. The stream flows northerly to its confluence with the North Fork. The upper portion is in mountainous terrain and the lower portion is in the foothills. The area is characteristic of the Rocky Mountain Front with its abundant glacial materials. Stream substrate ranges from gravel to large boulders. Stream gradient averages 165 feet/mile through the reach. Water clarity is good. There is one tributary, the Middle Fork.

The riparian areas consist of rock, conifers, willows and cottonwoods. The lower portion is heavily vegetated with willows and resembles a swamp due to numerous beaver dams. In some areas, vegetation is sparse due to past flooding.

Land use beyond the riparian zone is national forest, livestock grazing and hayfields. Recreation is popular in the area. Landownership is 60% private and 40% national forest. Access is by permission on trails across private lands. This trail system crosses the stream with one bridge and one ford. There are two diversions for irrigation.

**GAME FISH PRESENT:** Westslope cutthroat trout, brook trout

**FISHERY:**

The South Fork Dupuyer Creek contains important habitat necessary to sustain the westslope cutthroat trout, a "Species of Special Concern."

Westslope cutthroat is the only species found above a barrier near the transition between the mountain and foothills sections. Below the barrier (Sec. 36B, T27N, R9W) the population is composed of westslope cutthroat and brook trout. Table 3-72 shows the results of a snorkel survey conducted above the barrier on August 25, 1987. Forage fish include mottled sculpin.

Table 3-72. Snorkel survey results in 835 feet of South Fork Dupuyer Creek, August 25, 1987 (Sec. 35D, T27N, R9W).

Species	Number <6"	Number >6"
Westslope cutthroat	12	46

Fishery problems include bank erosion and shifting of streambed materials during periods of high flows.

#### WILDLIFE:

Big game animals using the area include bighorn sheep, mountain goat, elk, mule deer, white-tailed deer, black bear, and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include all three species of mountain grouse. Furbearers include beaver, mink, bobcat, lynx and wolverine. Coyote and various raptors also occur.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 281-foot-section of the South Fork Dupuyer Creek in Sec. 36B, T27N, R9W. Four riffle cross sections were established. One cross section was not used due to calibration problems. The WETP computer program was calibrated to field data collected at flows of 10.9, 16.3 and 35.8 cfs.

The relationship between wetted perimeter and flow for a composite of three riffle cross sections is shown in Figure 3-60. An upper inflection point occurs at an approximate flow of 6 cfs.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing trout populations and their spawning and rearing habitat. The flow is essential to protect the westslope cutthroat, a "Species of Special Concern." These flows will also protect those wildlife species which depend upon the stream and its riparian zone for food, water and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of South Fork Dupuyer Creek.

#### FLOW REQUEST:

January 1-December 31 -- 6 cfs (4,344 A.F./yr.)

# SOUTH FORK DUPUYER CREEK

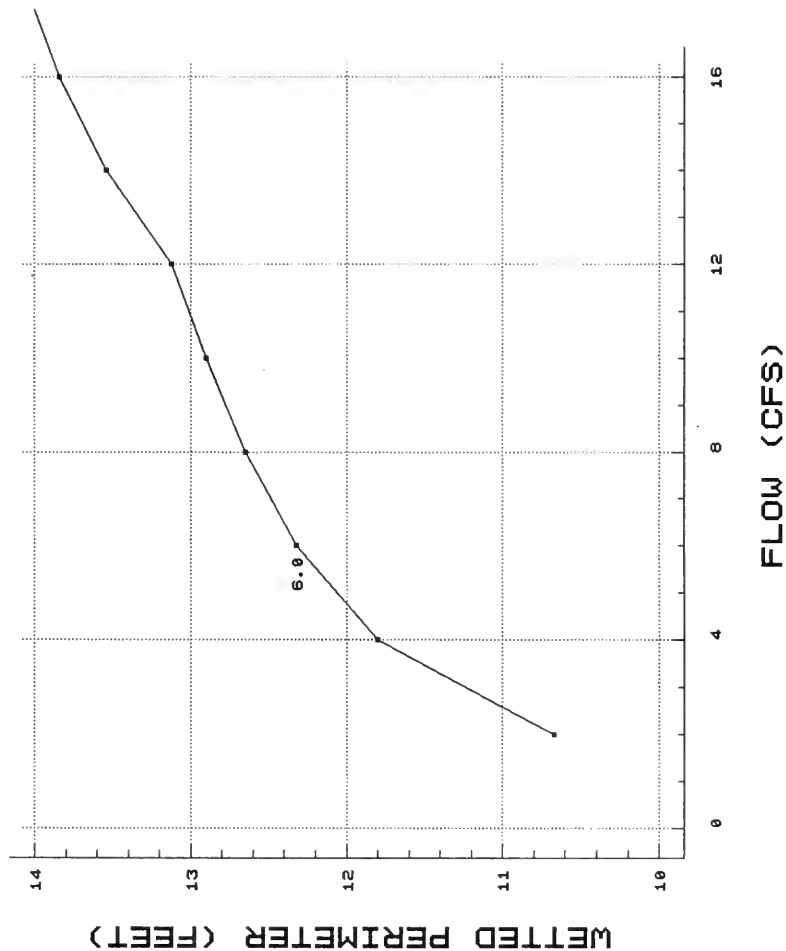


Figure 3-60. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in the South Fork Dupuyer Creek.

**STREAM NAME:** North Fork Dupuyer Creek

**STREAM REACH:** From the headwaters to the mouth -- 6 miles

**LOCATION:** Sec. 28B, T27N, R9W, to Sec. 18C, T27N, R8W

**DESCRIPTION OF STREAM REACH:**

The North Fork Dupuyer Creek originates within the Lewis and Clark National Forest approximately 15 miles southwest of Dupuyer. The stream flows north and east to its confluence with the South Fork. The upper reaches are characterized by glacial materials ranging from gravel to very large boulders. The surrounding area is steep, mountainous terrain. The lower reaches also contain glacial materials but the stream enters a foothills type setting. Overall stream gradient is about 110 feet/mile. Water clarity is good.

The riparian area varies from rock and conifers to willows and small cottonwoods. The area exhibits shallow soils and vegetation is sparse along much of the floodplain, a result of past floods.

Land use beyond the riparian zone is national forest, grazing and some hayfields. The area is very popular for big game hunting. Land ownership is 60% private and 40% national forest. Access at present is controlled by private landowners during hunting seasons but vehicle access is generally permitted to a parking area. Access beyond this point is by foot or horseback. Vehicle access to the national forest is permitted throughout the summer.

The North Fork has one road that leads into the national forest. This road has a ford crossing the stream. There are some small irrigation diversions for hayfields.

**GAME FISH PRESENT:** Westslope cutthroat trout, brook trout

**FISHERY:**

The North Fork Dupuyer Creek is important from the standpoint that it contains habitat necessary to sustain the westslope cutthroat trout, a "Species of Special Concern."

The trout population is equally divided between westslope cutthroat and brook trout. Electrofishing surveys conducted



in recent years indicate that westslope cutthroat range in length from 3.5-10.5 inches and brook trout from 3.9-10.6 inches. Results of a snorkel survey conducted on August 25, 1987, are presented in Table 3-73. Forage fish include mottled sculpin.

Table 3-73. Snorkel survey results in 300 feet of North Fork Dupuyer Creek, August 25, 1987 (Sec. 14D, T27N, R9W).

Species	Number <6"	Number >6"	Total
Westslope cutthroat	24	6	30
Brook trout	12	20	32

Fishery problems include low flows in the lower reaches due to natural conditions and irrigation withdrawals. Due to the glacial materials present, the stream is subject to bank erosion during high flows. Stream braiding also occurs in the lower reaches.

#### WILDLIFE:

Big game animals found in the area include bighorn sheep, mountain goat, elk, mule deer, white-tailed deer, black bear, and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include blue grouse, spruce grouse and ruffed grouse. Furbearers include beaver, mink, bobcat, lynx and wolverine. Other wildlife species include coyote and various raptors.

#### WETTED PERIMETER:

Cross-sectional data were collected on the North Fork Dupuyer Creek in Sec. 13C, T27N, R9W. Four riffle cross sections were established. One cross section was eliminated due to calibration problems. The WETP computer program was calibrated to field data collected at flows of 13.7, 22.3 and 42.9 cfs.

The relationship between wetted perimeter and flow for a composite of three riffle cross sections is shown in Figure 3-61. Lower and upper inflection points occur at approximate flows of 8 and 12 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations and their spawning and rearing habitats. The flow is essential to protect the westslope cutthroat, a "Species of Special Concern." These flows will also assist in maintenance of habitat for those wildlife species which depend upon the stream and its riparian zone for food, water and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of North Fork Dupuyer Creek.

#### **FLOW REQUEST:**

January 1-December 31 -- 12 cfs (8,688 A.F./yr.)

# NORTH FORK DUPUYER CREEK

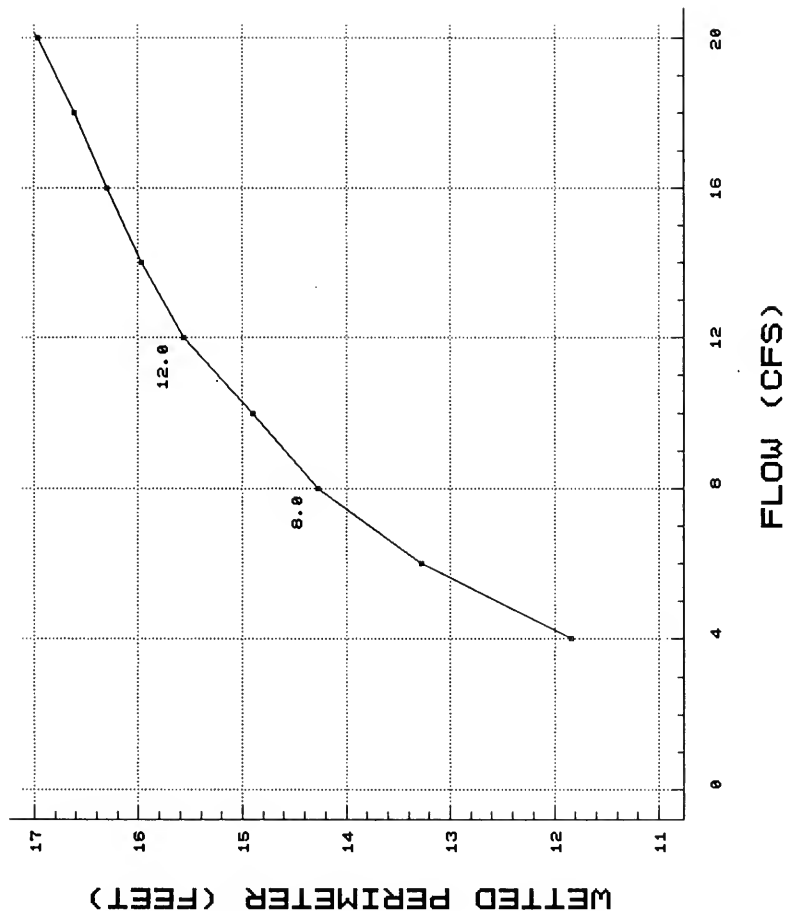


Figure 3-61. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in the North Fork Dupuyer Creek.

**STREAM NAME:** Dupuyer Creek

**STREAM REACH:** From the headwaters to the mouth -- 32.0 miles

**LOCATION:** Sec. 18C, T27N, R8W, to Sec. 36A, T30N, R6W

**DESCRIPTION OF STREAM REACH:**

Dupuyer Creek originates at the junction of its North and South forks approximately 11 miles southwest of Dupuyer. This foothills stream meanders through a medium-sized valley with rolling hills above the valley floor. The stream is of glacial origin with abundant gravel-cobble substrate. Stream gradient is approximately 50 feet/mile. Water clarity is good with the exception of spring runoff or after heavy rainfall. Important tributaries are Scoffin and Sheep creeks.

A USGS stream gauge located 8 miles southwest of Valier recorded flows from July, 1912 through September, 1937. Minimum discharge was zero flow on several occasions with maximum discharge of 3,330 cfs on June 7, 1934. Mean annual flow for the 25-year period of record was 49.3 cfs. Below the town of Dupuyer, irrigation demand occasionally causes dewatering.

Dupuyer Creek meanders throughout a dense willow/cottonwood valley above Dupuyer. Below Dupuyer, cottonwoods are not as common. Several locations exhibit areas of denuded vegetation, bank erosion and channel changes resulting from the floods of 1964 and 1975.

Land use beyond the riparian area includes hayfields and livestock grazing (cattle, horses, sheep) with some grain fields below Dupuyer. Land ownership is 95% private and 5% state. Most landowners will grant access upon request. The stream and adjoining land have historically been used for agriculture and recreation. Minor water quality problems exist along the stream from small-scale barnyard pollution.

Dupuyer Creek is paralleled by a county road having one bridge and one ford crossing. There are also several private bridges and fords. There are several diversions along Dupuyer Creek with the largest diverting water to Lake Frances. Water is also diverted from Birch Creek into Dupuyer Creek for transfer to Lake Frances.

**GAME FISH PRESENT:** Brook trout, rainbow trout, mountain whitefish

**FISHERY:**

Dupuyer Creek is important from the standpoint that it provides a brook/rainbow trout fishery for local people who have few other trout streams in the area.

The resident fishery is composed of brook trout (50%), rainbow trout (38%) and mountain whitefish (12%). Brook trout up to 1 pound occasionally occur. Results of electrofishing surveys are presented in Table 3-74. Forage fish include mottled sculpin and longnose dace.

Table 3-74. Summary of electrofishing survey data for 770 feet of Dupuyer Creek, August 3, 1976 (Sec. 23C, T28N, R8W).

Species	Number Captured	Length Range (in.)
Brook trout	25	4.6 - 13.2
Rainbow trout	19	2.9 - 12.0
Mountain whitefish	6	5.9 - 13.8

Fishery problems include occasional dewatering for irrigation purposes. In some areas, active bank erosion is occurring which was caused by flooding in 1964 and 1975. Brush removal and farming adjacent to streambanks is also contributing to bank erosion. Fishing pressure estimated in a 1982-86 angler survey was an average of 620-angler days/year (McFarland 1989).

**WILDLIFE:**

Big game species using the area include elk, mule deer, white-tailed deer, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring and fall. Upland birds include Hungarian partridge, sharp-tailed grouse, ring-necked pheasant and ruffed grouse. Other wildlife includes various species of ducks, beaver, muskrat, mink, raccoon, coyote, rabbit, golden eagle and various species of hawks and owls.

**WETTED PERIMETER:**

Cross-sectional data were collected in a 179-foot section of Dupuyer Creek approximately 6.5 miles west of the town of

Dupuyer in Sec. 23C, T28N, R8W. Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 39.5, 67.3, and 147.6 cfs.

The relationship between wetted perimeter and flow for a composite of four riffle cross sections is shown in Figure 3-62. An upper inflection point occurs at an approximate flow of 12 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations and their habitat (including spawning, rearing and food producing areas). These flows will also help protect those wildlife species, including the federally-threatened grizzly bear, which depend upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 12 cfs (8,688 A.F./yr.)

# DUPUYER CREEK

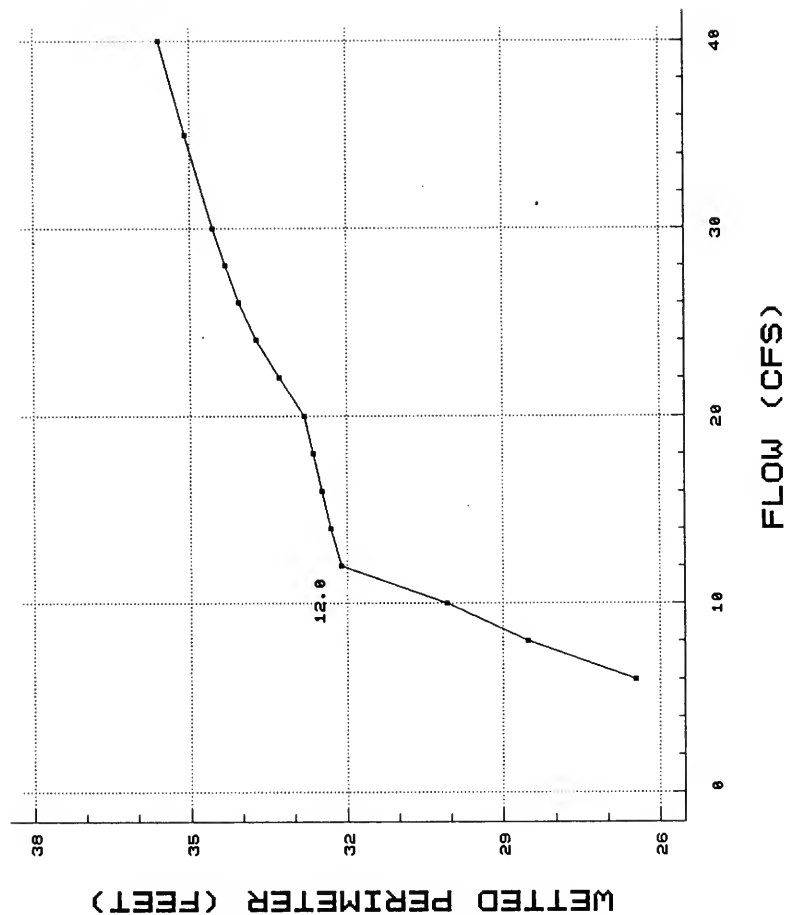


Figure 3-62. The relationship between wetted perimeter and flow for a composite of four rifle cross sections in Dupuyer Creek.

**STREAM NAME:** South Badger Creek

**STREAM REACH:** From the headwaters to the mouth -- 8 miles

**LOCATION:** Sec. 29B, T28N, R11W to Sec. 30C, T29N, R11W

**DESCRIPTION OF STREAM REACH:**

South Badger Creek originates under the Continental Divide near Badger Pass. It flows northerly to its confluence with North Badger Creek. The surrounding area is timbered and the stream flows over a substrate of gravel, cobbles and boulders. Stream gradient is approximately 110 feet/mile. Water is generally clear but becomes turbid following snow melt and rain storms. An important tributary is Elbow Creek.

The riparian area consists of rocky cliffs, willows, alder and coniferous trees. Floodplain vegetation is sparse in some areas due to recent floods. Land ownership is 100% public (Lewis and Clark National Forest). Access is by foot, horseback and trail bike. Land uses include many forms of recreation. Historically, the Blackfeet Indians have reserved the right to cut timber for agency and school purposes and also the right to hunt and fish upon the lands. The only access to the area is by Forest Service trails.

**GAME FISH PRESENT:** Westslope cutthroat trout, brook trout, rainbow trout

**FISHERY:**

South Badger Creek is very important from the standpoint that it contains habitat to sustain a "Species of Special Concern," the native westslope cutthroat trout. There are only a few other streams along the east slope that still maintain this species.

The fish population is composed of westslope cutthroat (70%) and brook trout (30%). A few rainbow trout occur below a barrier in the lower 1/2 mile of the stream reach. Forage fish include mottled sculpin. Fish sampled by hook-and-line surveys in 1977 are presented in Table 3-75. The cutthroat in this stream are considered genetically pure due to the close proximity of North Badger Creek where tests showed pure westslope cutthroat were present (see write-up for North Badger Creek).



Table 3-75. Summary of a hook-and-line survey in the South Fork of Badger Creek, August 3, 1977 (Sec. 30, T29N, R11W; Sec. 36, T29N, R12W; Secs. 1 & 11, T28N, R12W).

Species	Number Captured	Length Range (in.)
Westslope cutthroat	13	7.8 - 15.0
Brook trout	5	8.0 - 9.5

Several barriers are found within the stream reach. These barriers are important in that they isolate westslope cutthroat from rainbow trout. Rainbow trout occur below the lowermost barrier only, approximately 1/2 mile from the mouth.

#### WILDLIFE:

Big game animals found in the area include elk, bighorn sheep, mountain goat, mule deer, white-tailed deer, moose, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include blue, ruffed and spruce grouse. Other wildlife species include harlequin ducks, mink, beaver, wolverine, coyote, mountain lion, bobcat, lynx, hawks, owls and golden eagles. The bald eagle, an endangered species, migrates through the area in spring and fall.

#### WETTED PERIMETER:

Cross-sectional data were collected on South Badger Creek in Sec.30C, T29N, R11W. Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 34.6, 43.7 and 75.8 cfs.

The relationship between wetted perimeter and flow for a composite of the four riffle cross sections is shown in Figure 3-63. Lower and upper inflection points occur at approximate flows of 12 and 40 cfs, respectively.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing trout population which includes the westslope cutthroat trout, a "Species of Special Concern." The flow will also assist in maintenance of habitat for wildlife species, including the threatened grizzly bear, that depend upon the stream and its riparian zone for food, water and shelter.

#### FLOW REQUEST:

January 1-December 31 -- 40 cfs (28,959 A.F./yr.)

# SOUTH BADGER CREEK

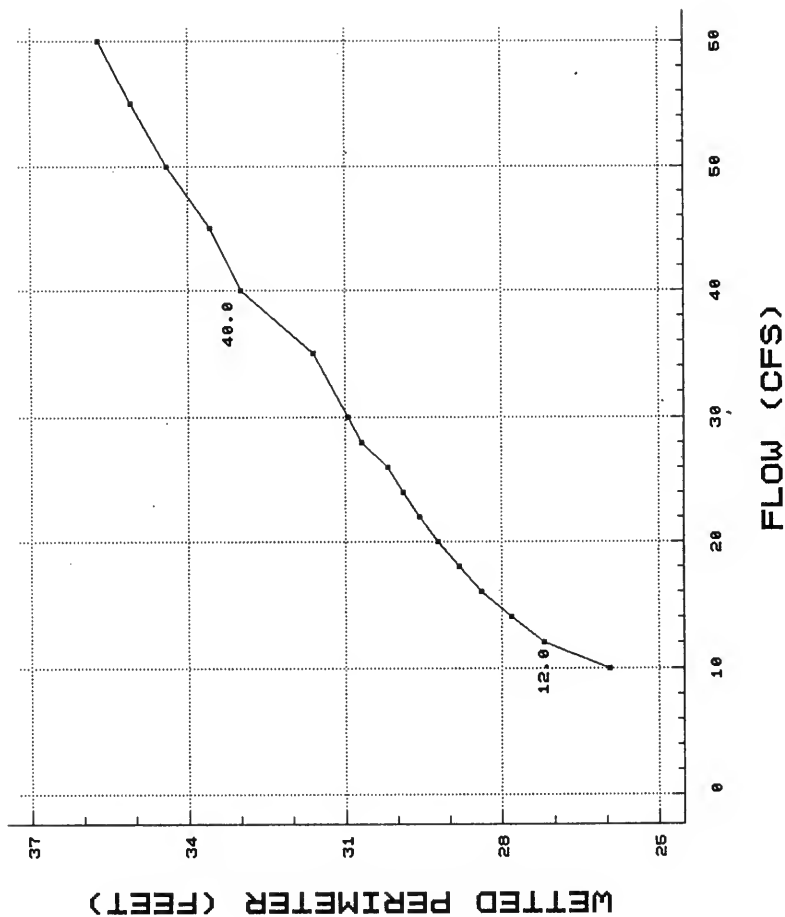


Figure 3-63. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in South Badger Creek.

**STREAM NAME:** North Badger Creek

**STREAM REACH:** From the headwaters to the mouth -- 8 miles

**LOCATION:** Sec. 18A, T28N, R12W to Sec. 30C, T29N, R11W

**DESCRIPTION OF STREAM REACH:**

North Badger Creek originates east of the Continental Divide near Big Lodge Mountain. The stream flows northeast towards the Badger Guard Station and then turns southeast to its confluence with South Badger Creek. The surrounding area is coniferous forest with the stream flowing through a gravel/cobble/boulder substrate. A portion of the stream is carved through a limestone canyon. Stream gradient is approximately 135 feet/mile. The water is clear but colors up during snow melt and rain storms. Important tributaries include Pool, Lee, Badger Cabin and Red Poacher creeks.

The riparian area consists of rocky cliffs, willows, alder and coniferous trees. Vegetation is lacking in some areas due to past flooding. Land ownership is 100% public (Lewis and Clark National Forest). Access is by foot, horseback and trail bike. Land uses include many forms of recreation (fishing, hunting, snowmobiling, etc.) and grazing. Historically, the Blackfeet Indians have reserved the right to cut timber for agency and school purposes and also the right to hunt and fish upon the lands.

The only access to the area is by Forest Service trails. Old seismograph roads that parallel the upper reaches are still evident. These roads are occasionally used for administrative purposes.

**GAME FISH PRESENT:** Westslope cutthroat trout

**FISHERY:**

North Badger Creek is very important from the standpoint that it contains habitat to sustain a "Species of Special Concern," the native westslope cutthroat trout. There are only a few other streams along the east slope that still maintain this species.

Westslope cutthroat trout make up 100% of the game fish population in North Badger Creek. Forage fish include mottled

sculpin. A total of 22 trout (6.3-12.0 inches) were collected in August, 1985 for testing of their genetic purity. These fish were found to be 100% pure westslope cutthroat trout. Previous fish sampling by electrofishing and hook-and-line in 1977 produced 41 cutthroat ranging in length from 2.8-14.6 inches.

Several barriers are found throughout the stream reach, with the lowermost barrier located approximately 3/4 mile above the mouth. The barriers keep the westslope cutthroat population isolated from other species, which is necessary to maintain the genetic purity of this species.

#### **WILDLIFE:**

Big game animals found in the area include elk, bighorn sheep, mountain goat, mule deer, white-tailed deer, moose, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include blue, ruffed and spruce grouse. Other wildlife species are mink, beaver, wolverine, coyote, mountain lion, bobcat, lynx, harlequin ducks, hawks, owls and golden eagles. The bald eagle, an endangered species, migrates through the area in spring and fall.

#### **WETTED PERIMETER:**

Cross-sectional data were collected on North Badger Creek in Sec. 30C, T29N, R11W. Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 18.1, 22.1 and 55.5 cfs.

The relationship between wetted perimeter and flow for a composite of four riffle cross sections is shown in Figure 3-64. An upper inflection point occurs at approximately 14 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing population of westslope cutthroat trout. The flow will also assist in maintenance of habitat for wildlife species, including the threatened grizzly bear, that depend upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 14 cfs (10,136 A.F./yr.)

# NORTH BADGER CREEK

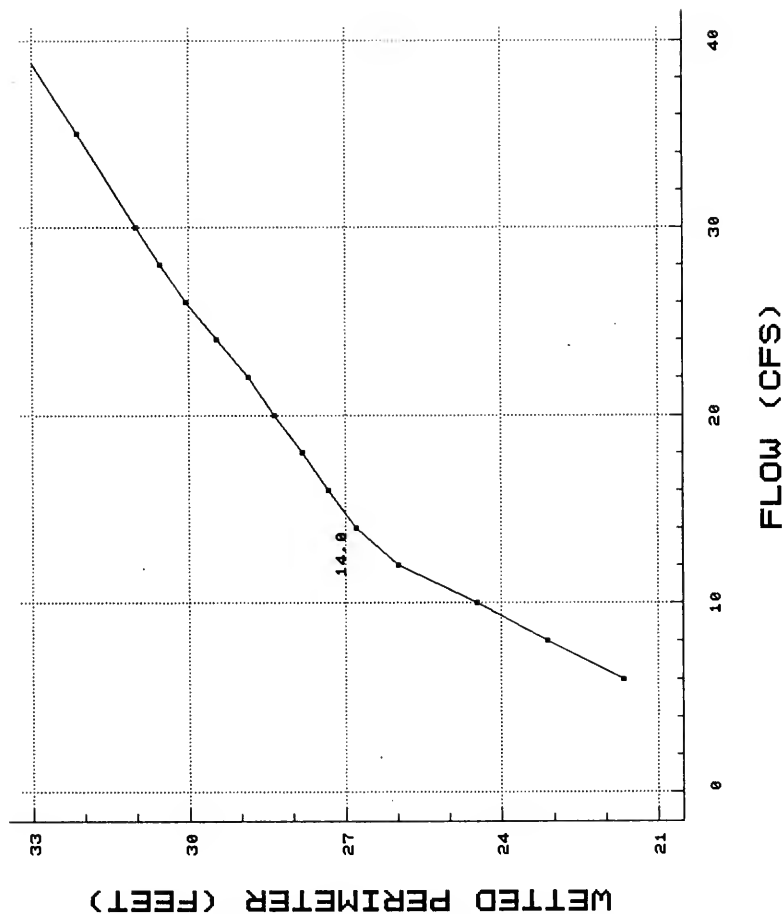


Figure 3-64. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in North Badger Creek.

**STREAM NAME:** Badger Creek

**STREAM REACH:** From the confluence of North and South Badger creeks to the national forest/Blackfeet Indian Reservation Boundary -- 6.5 miles

**LOCATION:** Sec. 30C, T29N, R11W to Sec. 3C, T30N, R11W

**DESCRIPTION OF STREAM REACH:**

Badger Creek is formed by the junction of the North and South Badger creeks. Tributaries within this reach include Lonesome Creek, Limestone Creek and Lookout Creek. Badger Creek has a substrate of gravel, cobbles and boulders. The valley floor is quite wide and flanked by timbered mountains. Stream gradient is approximately 50 feet/mile. At the lower end of the reach, the floodplain narrows and gradient increases as the stream flows through a canyon. Water clarity is good.

A USGS stream gauge is located approximately 12 miles downstream from the end of the stream reach. Records kept between 1951-87 show an average discharge of 222 cfs (160,800 acre-feet/year) with a maximum of 49,700 cfs on June 8, 1964, and a minimum of 6.5 cfs on September 17, 1984. The Four Horns Canal diverts water from Badger Creek 3.4 miles upstream from the gauge.

The riparian area is mainly conifers, willows and alder. Some areas are lacking in vegetation due to past flooding. Land ownership is 100% public (Lewis and Clark National Forest). Transportation within the area is by Forest Service trails which are accessible by foot, horseback and trail bike. Use of the area is related to general recreation. Historical use includes the right of the Blackfeet Indians to cut timber for agency and school purposes and the right to hunt and fish.

**GAME FISH PRESENT:** Rainbow trout, westslope cutthroat trout, brook trout

**FISHERY:**

Badger Creek is an important fishery because it contains the westslope cutthroat trout, a "Species of Special Concern." Rainbow trout are more common than cutthroat, and brook trout are also present. Fish sampled by hook-and-line over a

several year period ranged in length from 9-16 inches. Forage fish found in the stream include mottled sculpin.

#### **WILDLIFE:**

Big game animals using the area include elk, bighorn sheep, mountain goat, mule deer, white-tailed deer, moose, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. All 3 species of mountain grouse are found here. Other wildlife include mink, wolverine, coyote, mountain lion, bobcat, lynx, harlequin duck and various raptors. The bald eagle, an endangered species, migrates through the area in spring and fall.

#### **WETTED PERIMETER:**

The wetted perimeter method was not used on Badger Creek due to the difficulty of access to this remote stream. Instead, the fixed percentage method was used based on an average annual flow estimate made by the USGS. The flow estimate at the Blackfeet Reservation boundary for the 1937-86 base period was 151 cfs (Parrett 1989).

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout population, which includes the westslope cutthroat trout, a "Species of Special Concern." The flow will also assist in maintenance of habitat for wildlife species, including the threatened grizzly bear, that depend upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 60 cfs (43,438 A.F./yr.)

A flow recommendation derived from the wetted perimeter method is unavailable for Badger Creek. The instream flow request is, therefore, based on the fixed percentage method described in Volume 1. Under this method, 40% of the average annual flow is being recorded for those Marias River tributaries having high fishery values. An average annual flow of 151 cfs was estimated for Badger Creek. An instream flow of 60 cfs is, therefore, requested.

**STREAM NAME:** South Fork Two Medicine River

**STREAM REACH:** From the Headwaters to the Forest/Blackfeet Indian Reservation Boundary -- 15.5 miles

**LOCATION:** Sec. 16C, T29N, R12W to Sec. 5D, T30N, R12W

**DESCRIPTION OF STREAM REACH:**

The South Fork Two Medicine River has its origin near the Badger Guard Station approximately 14 miles southeast of East Glacier. The stream flows northwest towards Glacier Park and then turns northeast towards the forest boundary. The surrounding area is timber covered mountains that drain the east side of the Continental Divide. Stream materials range from gravel to cobble and boulders. Stream gradient is approximately 75 feet/mile. The water is generally clear but becomes quite turbid during snow melt and rain storms. Important tributaries include Whiterock, Sidney, Woods, Lost Shirt, Benson, Summit, Hall, Box and Hyde creeks.

The riparian area consists of willows, alder, birch, cottonwoods and spruce. As is true of most streams draining the East Slope of the Rocky Mountains, streambank vegetation is lacking in some areas due to past flooding. Land ownership is 80% public (Lewis and Clark National Forest) and 20% private. Access to public land is possible by foot, horseback and trail bike. Land uses include many forms of recreation (fishing, hunting, snowmobiling, etc.), grazing and logging. Historically, the Blackfeet Indians have reserved the right to cut timber for agency and school purposes and also to hunt and fish upon the lands.

The nearest transportation corridor is Highway 2 which runs north of the river. The stream and surrounding area shows scars of past seismograph roads which are now used in part by the Forest Service for administrative purposes. A natural gas pipeline parallels Highway 2, north of the river.

**GAME FISH PRESENT:** Westslope cutthroat trout, rainbow trout, mountain whitefish



## **FISHERY:**

The South Fork Two Medicine River is very important from the standpoint that it contains habitat to sustain a "Species of Special Concern," the native westslope cutthroat trout. This stream, plus a few others, are the only streams along the east slope that still contain this species.

Westslope cutthroat are the only species found in the upper 7 miles. In the remaining 8.5 miles, rainbow trout make up 50% of the population, westslope cutthroat trout (35%) and mountain whitefish (15%). Forage species include mottled sculpin. During a snorkel survey on August 26, 1987, seven westslope cutthroat less than 6 inches and 17 westslope cutthroat greater than 6 inches were observed in 600 feet of stream. Fish populations were previously sampled by electrofishing and hook-and-line surveys in 1977 and produced 36 westslope cutthroat trout between 3.3-15.0 inches in length.

A total of 19 cutthroat (3.6-9.8 inches) were collected in August, 1984 for laboratory testing of genetic purity. These fish, from the upper portion of the river, were found to be 97% pure westslope cutthroat trout.

Fishery problems include siltation from old seismograph roads and their stream crossings. Also, naturally occurring low streamflow in fall and winter may limit fish populations. Snowmelt and heavy rains cause increased sediment in the stream.

A natural barrier is located approximately seven miles downstream from the headwaters. This barrier isolates the pure westslope cutthroat from other species below.

## **WILDLIFE:**

Big game animals found in the area include elk, bighorn sheep, mountain goat, mule deer, white-tailed deer, moose, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include blue, ruffed and spruce grouse. Other wildlife species include harlequin ducks, mink, beaver, wolverine, coyote, mountain lion, bobcat, lynx, hawks, owls and golden eagles. The bald eagle, an endangered species, migrates through the area in spring and fall.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 208-foot section of the South Fork Two Medicine River are located in Sec. 28C, T30N, R13W. Three riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 22.3, 71.4 and 200.5 cfs.

The relationship between wetted perimeter and flow for a composite of three riffle cross sections is shown in Figure 3-65. Lower and upper inflection points occur at approximate flows of 8 and 16 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout population, which includes the westslope cutthroat trout, a "Species of Special Concern." The flow will also assist in maintenance of habitat for wildlife species, including the threatened grizzly bear, that depend upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 16 cfs (11,583 A.F./yr.)

# SOUTH FORK TWO MEDICINE RIVER

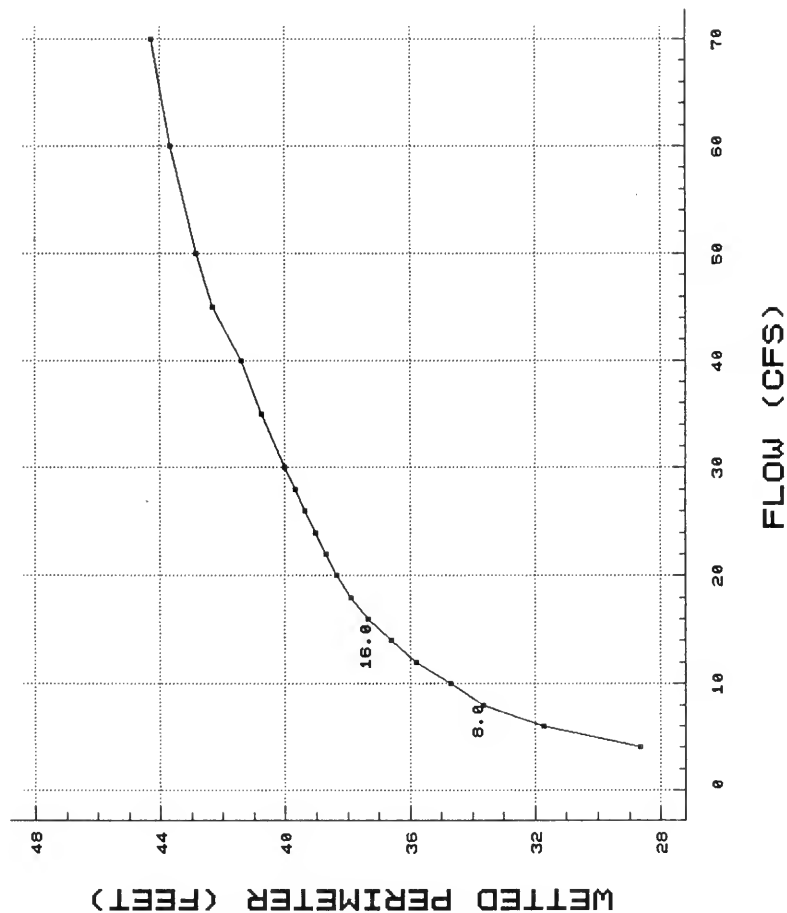


Figure 3-65. The relationship between wetted perimeter and flow for a composite of three rifle cross sections in South Fork Two Medicine River.

**STREAM NAME:** Cut Bank Creek

**STREAM REACH:** From the Blackfeet Reservation boundary to the mouth  
-- 19 miles

**LOCATION:** Sec. 34A, T34N, R6W to Sec. 35C, T32N, R5W

**DESCRIPTION OF STREAM REACH:**

Cut Bank Creek originates within the Blackfeet Indian Reservation, but leaves the reservation about 19 miles upstream from its mouth. From this point downstream, Cut Bank Creek forms the eastern boundary of the reservation until its confluence with Birch Creek to form the Marias River. From the reservation boundary, the stream flows through a medium-sized valley flanked by hills which rise to higher benchlands. Sandstone outcroppings are common and often extend into the stream. Sand, gravel, and cobble substrates are found throughout the reach. Stream gradient is about 25 feet/mile. The water is slightly turbid. Tributaries include Spring Creek and Old Maids Coulee.

Land uses include pasture and hayland. Land ownership east and north of Cut Bank Creek is approximately 85% private and 15% federal. Lands west and south are within the reservation. The city of Cut Bank has a water purification plant adjacent to Cut Bank Creek which diverts water by means of a dam across the stream. There are some hay fields irrigated by pumping water directly from the stream.

A USGS gauge operated at stream mile 17.7 between 1905-87 (44-years interrupted record) recorded a mean annual flow of 187 cfs.

**GAME FISH PRESENT:** Rainbow trout, brown trout, mountain whitefish, burbot

**FISHERY:**

Cut Bank Creek is an important fishery because it is the only trout stream readily available to persons in the Cut Bank area. Catchable rainbow trout are stocked annually to supplement a few wild fish. Brown trout introduced in 1965 have established a self-sustaining population. Forage fish include longnose dace, emerald shiner, fathead minnow, and mottled sculpin. Water temperatures are fairly warm in late

summer, especially when low flows occur. The dam across the stream at the city water plant acts as a fish barrier.

#### **WILDLIFE:**

Big game animals using the area include mule deer and white-tailed deer. Upland game birds include Hungarian partridge and sharp-tailed grouse. Raptors and various furbearers also occur in the area.

#### **WETTED PERIMETER:**

Most of Cut Bank Creek is entirely within the Blackfeet Indian Reservation and the remainder is a reservation boundary stream. DFWP did not conduct wetted perimeter studies on the stream. Instead, the requested flow was determined by the fixed percentage method described in Volume 1.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout fishery. The flow will also assist in maintenance of habitat for wildlife species that depend upon the stream for food, water, and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 75 cfs (54,297 A.F./yr.)

A flow recommendation derived from the wetted perimeter method is unavailable for Cut Bank Creek. The instream flow request is, therefore, based on the fixed percentage method described in Volume 1. Under this method, 40% of the average annual flow is being requested for those Marias River tributaries having high fishery values. An average annual flow of 187 cfs was recorded by the USGS for Cut Bank Creek at Cut Bank for a 44-year period of record between 1905-87. An instream flow of 75 cfs is, therefore, requested.



## Teton River Drainage

Figure 3-66 is a map which shows the locations of the following streams discussed in this section.

Teton River  
McDonald Creek  
South Fork Deep Creek  
North Fork Deep Creek  
Deep Creek  
Spring Creek







**STREAM NAME:** Teton River

**DESCRIPTION OF THE BASIN:**

The Teton River Basin is located in Teton and Chouteau counties of Northcentral Montana. The headwaters originate along and within the east front of the Rocky Mountains. Principal tributaries include Deep Creek, McDonald Creek, Spring Creek and Muddy Creek. The Teton River flows approximately 175 miles in an easterly direction and enters the Marias River at Loma. Yearly precipitation averages 12-14 inches, with higher amounts occurring near and in the mountains.

Choteau is the largest town within the basin, having a population of about 1,600. Smaller communities include Dutton, Bynum, Pendroy, Agawam, Farmington and Collins.

The major land uses are for crops and livestock. Approximately 80,000 acres are irrigated in the basin by many private individuals and four local ditch companies. Off-stream storage is held in Bynum, Eureka and Farmers Reservoirs, and Eyraud Lakes.

Approximately 15% of the basin is national forest. Some firewood gathering and small timber sales are permitted. Considerable exploration for oil and gas has occurred with several shallow wells presently producing oil in the northern part of the basin. Three producing gas wells are located in the Blackleaf area. Although coal deposits are present, no commercial mining has taken place.

The Teton River Basin supports an abundance of fish and wildlife that provides good fishing and hunting. Native westslope cutthroat trout are found in headwater streams. Rainbow, brook and brown trout occur in the middle to upper reaches of several streams, while sauger, burbot, channel catfish and northern pike are found in the lower Teton River. Reservoir fisheries are composed of rainbow trout and northern pike/yellow perch or walleye/yellow perch. Most of the big game animals common to Montana are found in the area. These include elk, mule and white-tailed deer, mountain goat, bighorn sheep and antelope. The riparian areas provide the necessary habitat and travel corridors for black and grizzly bear. Upland birds and numerous waterfowl species are also common in the area.

**STREAM NAME:** Teton River

**STREAM REACH:** From the headwaters to the discharge from Priest Butte Lake near Choteau -- 33 miles

**LOCATION:** Sec. 33A, T25N, R8W, to Sec. 33C, T24N, R4W

**DESCRIPTION OF STREAM REACH:**

The Teton River begins with the junction of its North and South forks approximately 22 air miles northwest of Choteau. The stream originates in the foothills near the Rocky Mountain Front and flows generally eastward to Choteau along gently rolling hills and flat terrain. Stream substrate is characterized by glacial materials with abundant gravel, cobble and boulders. Due to the gravelly conditions, channel movement is quite active with channel braiding occurring in some areas. Stream gradient is about 35 feet/mile. Water clarity is good but becomes turbid with sudden increases in flow. Tributaries include McDonald, Deep and Spring Creeks.

USGS discharge records for the lower end of the reach are available from June, 1913 to June, 1919. Maximum discharge was 4,500 cfs on June 22, 1916, and a minimum of 1 cfs occurred between August 9-16, 1916. The low readings are thought to be influenced by the many diversions above the recording station.

The riparian area consists of willows and cottonwoods throughout most of the reach, with limber pine and aspen near the headwaters. Floods in 1964 and 1975 destroyed most of the stream bank vegetation. This vegetation is now beginning to recover.

Land uses include grazing and hayland with some grain crops along the lower portions. Landownership within the stream reach is approximately 80% private and 20% state. Stream access is controlled by private landowners but is usually granted upon request. The Teton River is crossed by two highway bridges near Choteau, seven county road bridges and several private bridges and fords.

Historical land and water uses includes recreation and agriculture. Approximately four miles of the lower portion of the reach flows through the Teton-Spring Creek Bird Preserve. There are several diversions from the Teton River

that divert small amounts of water, three diversions that can divert about 200 cfs, and one large diversion capable of withdrawing 1,000 cfs during flood conditions.

**GAME FISH PRESENT:** Brook trout, brown trout, rainbow trout, and mountain whitefish

**FISHERY:**

The Teton River provides a trout fishery for people in the local area. The portion of the reach above Choteau has mostly small brook trout (90%), fewer numbers of brown trout (8%), rainbow trout (1%) and mountain whitefish (1%). Portions of this stretch are subject to low flows or complete dewatering by irrigation diversions. The lower portions of the reach near Choteau experience low, but stable flows. The fishery is composed of good size brown trout (73%), mountain whitefish (21%) and rainbow trout (6%). Fish other than trout include longnose, white, mountain, and northern redbhorse suckers, longnose dace, mottled sculpin, lake chub, carp and goldeye. The brook trout population above Choteau was estimated during electrofishing surveys. These results are shown in Table 3-76.

Table 3-76. Population estimate for 5,140 feet of the Teton River, May 29, 1980 (Sec. 31A, T25N, R6W). (80% confidence intervals in parentheses.)

Species	Length Group	Number Estimate	Standing Crop (No./1,000 ft.)
Brook trout	2.9 - 4.9	273	53
	5.0 - 6.9	79	21
	7.0 - 10.3	45	10
Total		397 ( $\pm$ 96)	84 ( $\pm$ 20)

A 5.8-mile section of the Teton River below Choteau was electrofished to determine species composition and relative abundance. Survey results appear in Table 3-77.

Table 3-77. Survey electrofishing data for the Teton River, October 8, 1980 (Sec. 33C, T24N, R4W).

Species	Number Captured	Length Range
Brown trout	123	3.7 - 22.4
Mountain whitefish	36	6.1 - 20.6
Rainbow trout	10	8.5 - 18.5

Factors limiting the fishery of the Teton River include:

(1) dewatering for irrigation, (2) unstable streambed materials which cause erosion and siltation during high flows, and (3) removal of trees and other flood-related debris from the flood plain after the 1975 flood which added to the instability of the stream channel.

#### WILDLIFE:

Big game animals found in the area include white-tailed deer, mule deer, elk (occasionally in upper portions), black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include Hungarian partridge, sharp-tailed grouse, ring-necked pheasant and ruffed grouse. Furbearers include beaver, mink, muskrat and bobcat. Other wildlife found are coyote, fox and various raptors as well as numerous ducks after nearby ponds and lakes freeze. The bald eagle, an endangered species, uses the area during the winter months.

#### WETTED PERIMETER:

Cross-sectional data were collected in a section of the Teton River approximately 8 miles northwest of Choteau in Sec. 27D, T25N, R6W. Five riffle cross sections were established. One cross section was not used because of calibration problems. The WETP computer program was calibrated to field data collected at flows of 24.3, 27.4, 32.5 and 82.5 cfs.

The relationship between wetted perimeter and flow for a composite of four of the five riffle cross sections is shown in Figure 3-67. Lower and upper inflection points occur at approximate flows of 14 and 35 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations along with their spawning and rearing habitat. These flows will also protect those wildlife species which depend upon the stream and its riparian zone for food, water and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of the Teton River.

**FLOW REQUEST:**

January 1-December 31 -- 35 cfs (25,339 A.F./yr.)

# TETON RIVER

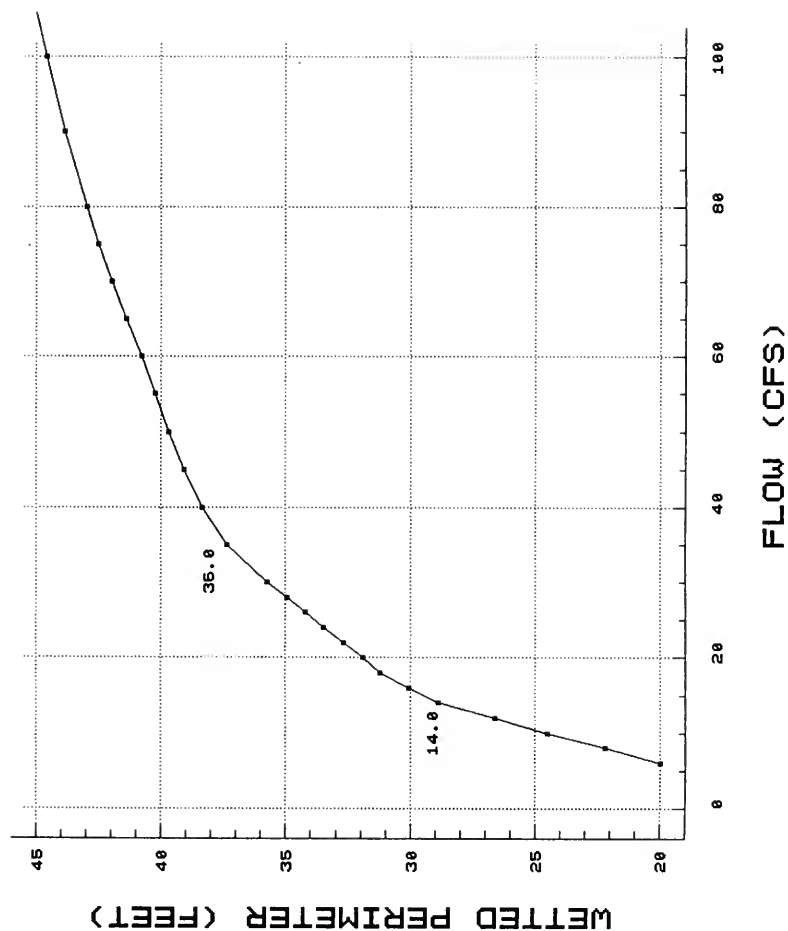


Figure 3-67. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in the Teton River.

**STREAM NAME:** McDonald Creek

**STREAM REACH:** From the Headwaters to the mouth - 8 miles

**LOCATION:** Sec. 4D, T24N, R7W to Sec. 34A, T25N, R6W

**DESCRIPTION OF STREAM REACH:**

McDonald Creek originates in The Pine Butte Swamp approximately 17 miles northwest of Choteau. The stream flows northeast to its confluence with the Teton River. It meanders through a gently-sloped valley flanked by rolling hills to the south and the Teton River to the north. Stream gradient is about 35 feet/mile. Water clarity is generally good and substrate is mostly muck interspersed with sand and gravel.

The riparian area is heavily vegetated with native grasses, willows, water birch, chokecherry, aspen and cottonwoods. Land ownership is 95% private and 5% state land. Current and historic land use is for livestock grazing, with some hayland. Access to the stream is via trails across private land, with permission usually granted upon request. There are several small diversions along its course, with the largest diverting flows close to the mouth.

**GAME FISH PRESENT:** Brook trout

**FISHERY:**

McDonald Creek provides a good fishery for small brook trout, the only game species present. Non-game species include mottled sculpin.

A 306-foot section of McDonald Creek was electrofished on July 23, 1986. The two-pass method (Leathe 1983) estimated the brook trout population to be 143 fish in the 306-foot section. They ranged in size from 3.5-9.1 inches.

McDonald Creek supports a beaver population and their dams create barriers to upstream movement of fish.



#### **WILDLIFE:**

Big game animals using the riparian area include mule deer, white-tailed deer, black bear, grizzly bear and an occasional elk. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include ruffed grouse, sharp-tailed grouse, Hungarian partridge and ring-necked pheasant. Furbearers include beaver, mink and muskrat. Other wildlife found are coyote, raccoon and various raptors and ducks.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 195-foot section of McDonald Creek in Sec. 33A, T25N, R6W. Four riffle cross sections were established. However, the wetted perimeter method was not used to assess instream flow needs. During the period when field measurements were made, flows were measured at 9.6, 12.1 and 15.7 cfs. The highest flow was measured in June and is thought to be influenced by ground water accretions from water diverted from the Teton River and through the drainage upstream. Discounting these accretions, McDonald Creek has a relatively stable flow regime and more closely resembles a spring creek than a typical snow-fed mountain stream. The low flow of 9.6 cfs was measured in October.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing brook trout fishery. The flow will also assist in maintenance of habitat for wildlife species, including the threatened grizzly bear, that depend upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 10 cfs (7,240 A.F/yr.)

Because of the spring creek-like characteristics of McDonald Creek, the wetted perimeter method was unsuitable to determine the flow requirement. The USGS estimated the base flow at 10 cfs (see Volume 1, Appendix A). Therefore, the flow requested is the base flow as determined from both DFWP and USGS data.

**STREAM NAME:** South Fork Deep Creek

**STREAM REACH:** From the headwaters to the mouth - 7 miles

**LOCATION:** Sec 22B, T23N, R9W to Sec 27A, T23N, R8W

**DESCRIPTION OF STREAM REACH:**

The South Fork of Deep Creek begins in the Lewis and Clark National Forest approximately 27 air miles southwest of Choteau. Three tributaries enter the stream within the forest. Average stream gradient is approximately 170 feet/mile. This stream has a substrate of gravel, cobbles and boulders in the upper portions of the reach and gravel and cobbles in the lower portion. Water clarity is generally good but becomes turbid with any runoff.

In the upper reaches, the riparian area is mostly conifers, while cottonwoods and willows are found in the lower portions. Some areas lack vegetation due to past flooding. Land uses include national forest and grazing. Historical uses include grazing, recreation, seismic and oil and gas exploration. Land ownership is 68% public (national forest and BLM), 18% state, and 14% private. Public access is denied across private land. Transportation within the forest is by foot or horseback on trails.

**GAME FISH PRESENT:** Rainbow trout, westslope cutthroat trout, brook trout

**FISHERY:**

The South Fork Deep Creek is an important fishery in that it contains the westslope cutthroat trout, a species of special concern. Rainbow and brook trout also occur. Forage fish include mottled sculpin. Due to access problems, recent fishery surveys have not been conducted.

#### **WILDLIFE:**

Big game animals include bighorn sheep, black bear, mule deer, white-tailed deer, and an occasional elk. The grizzly bear, a threatened species, uses the stream corridor during spring, summer, and fall. Game birds include mountain grouse, Hungarian partridge and sharp-tailed grouse. Other wildlife species include mountain lion, bobcat, coyote, mink, and various raptors.

#### **WETTED PERIMETER:**

The wetted perimeter method was not used on South Fork Deep Creek. Access to the stream is across private land and the landowner refused access permission. Consequently, the fixed-percentage method was used to determine the flow request.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout population, which includes the westslope cutthroat trout, a "Species of Special Concern. The flow will also protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water, and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of South Fork Deep Creek.

#### **FLOW REQUEST:**

January 1-December 31 -- 6.9 cfs (4,995 A.F./yr.)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for South Fork Deep Creek. The instream flow request is, therefore, based on the fixed-percentage method described in Volume 1. Under this method, 40% of the average annual flow is being requested for those Marias River tributaries having high fishery values. An average annual flow of 17.2 cfs was estimated by the USGS for South Fork Deep Creek near Choteau (see Volume 1, Appendix A). An instream flow of 6.9 cfs is, therefore, requested.

**STREAM NAME:** North Fork Deep Creek

**STREAM REACH:** From the headwaters to the mouth--8 miles

**LOCATION:** Sec 3D, T23N, R9W to Sec 27A, T23N, R8W

**DESCRIPTION OF STREAM REACH:**

The North Fork of Deep Creek originates within the Lewis and Clark National Forest southwest of Choteau. Several small tributaries enter the reach within the forest. Substrate is composed of gravel, cobbles, and boulders. Stream gradient is approximately 175 feet/mile. Water clarity is good except during runoff periods.

The riparian area is mostly conifers in the upper portions of the reach with cottonwoods and willows in the lower end. Past flooding is evident as indicated by the absence of streamside vegetation in some areas. Land uses include national forest and grazing. Land ownership is 50% public (national forest and BLM), 30% state, and 20% private. Stream access is essentially denied across private land. Historical land uses include grazing, seismic and oil and gas exploration and hunting. Transportation within the forest is by foot or horseback on trails. There is one small irrigation diversion.

**GAME FISH PRESENT:** Rainbow trout, westslope cutthroat trout, brook trout

**FISHERY:**

The North Fork Deep Creek is important from the standpoint that it contains a species of special concern, the westslope cutthroat trout. Recent fishery surveys have not been made due to access problems. Other game fish include rainbow and brook trout. Forage fish include mottled sculpin.

#### **WILDLIFE:**

Big game animals using the area include white-tailed deer, mule deer, bighorn sheep, black bear, and an occasional elk. The grizzly bear, a threatened species, uses the stream corridor during spring, summer, and fall. Upland birds include mountain grouse, sharp-tailed grouse, and Hungarian partridge. Other wildlife are mink, coyote, mountain lion, bobcat, and various raptors.

#### **WETTED PERIMETER:**

The wetted perimeter method was not used on North Fork Deep Creek. Access to the stream is across private land and the landowner refused access permission. Consequently, the fixed-percentage method was used to determine the flow request.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout population, which includes the westslope cutthroat trout, a "Species of Special Concern." The flow will also assist in maintenance of habitat for wildlife species that depend on the stream and its riparian zone for food, water, and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of North Fork Deep Creek.

#### **FLOW REQUEST:**

January 1-December 31 -- 7.2 cfs (5,212 A.F./yr.)

A flow recommendation derived from the wetted perimeter method is unavailable for North Fork Deep Creek. The instream flow request is, therefore, based on the fixed-percentage method described in Volume 1. Under this method, 40% of the average annual flow is being requested for those Marias River tributaries having high fishery values. An average annual flow of 18.0 cfs was estimated by the USGS for North Fork Deep Creek near Choteau (see Volume 1, Appendix A). An instream flow of 7.2 cfs is, therefore, requested.

**STREAM NAME:** Deep Creek

**STREAM REACH:** From the headwaters to the mouth - 28 miles.

**LOCATION:** Sec. 27A, T23N, R8W to Sec. 31C, T24N, R4W

**DESCRIPTION OF STREAM REACH:**

Deep Creek originates approximately 21 air miles southwest of Choteau with the junction of its North and South forks. The stream flows eastward from foothills adjacent to the Rocky Mountain Front and then through prairie land to its confluence with the Teton River near Choteau. The upper reaches are characterized by gravel and cobble substrate while the middle and lower reaches are of a more silty nature. Water clarity is generally slightly turbid with very turbid conditions during runoff. Stream gradient is about 33 feet/mile. Tributaries entering Deep Creek include Battle Creek and Willow Creek.

USGS discharge records are available from April 1911 through December 1924 from a station 5 miles southwest of Choteau. Maximum discharge was 3,700 cfs on June 21, 1916, and the minimum was 3.0 cfs on July 23, 1919. The average for the period of record was 70.4 cfs or 50,970 acre-feet per year.

The riparian area in the upper reaches is mostly cottonwoods and willows, while willows and birch are common in the middle reaches. The lower portions have only a few willows. Land uses beyond the riparian zone include grazing along with hay and some grain crops.

Landownership is 93% private and 7% state. Access is denied on some private land but generally granted on most other property. County road access is available at two locations. There are several private crossings throughout the stream reach.

Historical land and water uses include agriculture and recreation. There are several small irrigation diversions throughout the reach.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout, mountain whitefish, and westslope cutthroat trout

## **FISHERY:**

Deep Creek supports a locally important fishery. Rainbow trout, brook trout, mountain whitefish and westlope cutthroat trout are most common in the upper reaches while brown trout, rainbow trout and mountain whitefish occur in the lower reaches. Brown trout up to 14 inches and rainbow trout up to 16 inches are present in the stream according to 1987 DFWP electrofishing surveys in Sec. 20A, T23N, R5W. Brown trout were stocked in 1986 at three locations in an attempt to expand the range of this species in the stream. Other species found in Deep Creek include white, longnose and mountain sucker, lake chub, mottled sculpin and longnose dace.

Limiting factors in Deep Creek include low flows in the middle reaches from irrigation withdrawals and sediment transport during runoff conditions.

## **WILDLIFE:**

Big game animals include white-tailed deer, mule deer, an occasional elk, black bear and grizzly bear. The grizzly bear, a threatened species, uses the stream corridor during spring, summer and fall. Upland birds include Hungarian partridge, sharp-tailed grouse, and ring-necked pheasant. Furbearers include beaver, mink and muskrat. Other wildlife found in the area are coyote, fox and various raptors.

## **WETTED PERIMETER:**

Cross-sectional data were collected on Deep Creek in Sec. 20A, T23N, R5W. Four riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 15.0, 24.3, 27.4 and 41.7 cfs.

The relationship between wetted perimeter and flow for a composite of the four riffle cross sections is shown in Figure 3-68. Lower and upper inflection points occur at approximate flows of 6 and 18 cfs, respectively.

## **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations and their habitat. These flows will also protect

the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of Deep Creek.

**FLOW REQUEST:**

January 1-December 31 -- 18 cfs (13,031 A.F./yr.)



# DEEP CREEK

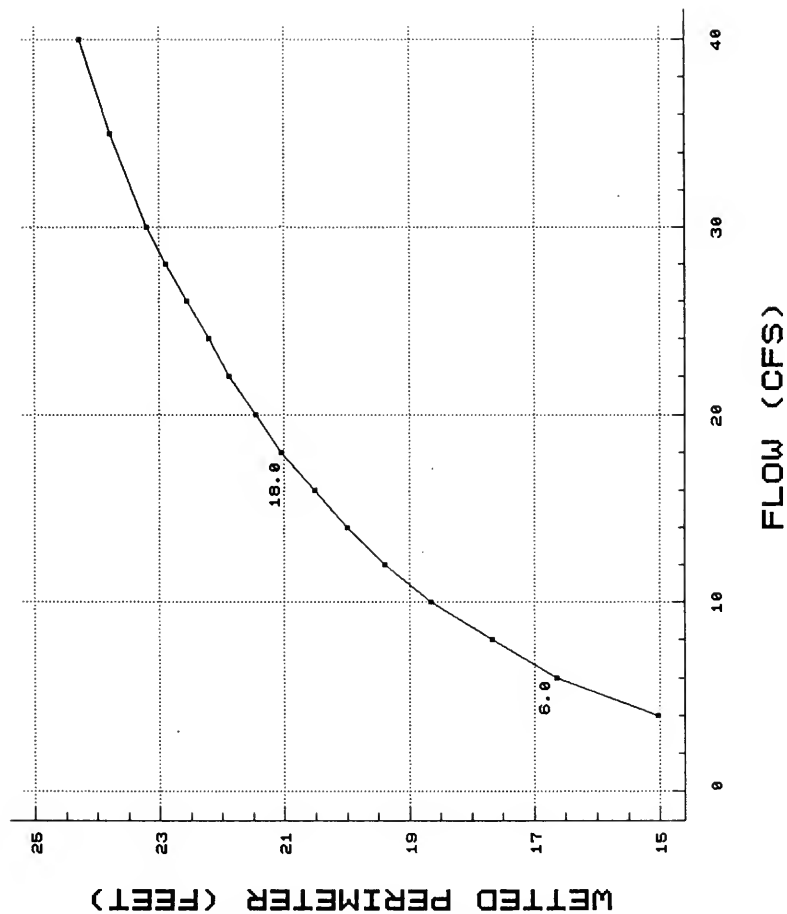


Figure 3-68.

The relationship between wetted perimeter and flow for a composite of four rifle cross sections in the Deep Creek.

**STREAM NAME:** Spring Creek

**STREAM REACH:** From the headwaters to the mouth - 10.5 miles

**LOCATION:** Sec. 4B, T24N, R5W to Sec. 33C, T24N, R4W

**DESCRIPTION OF STREAM REACH:**

Spring Creek originates approximately 6 miles northwest of Choteau, flowing southeast to its confluence with the Teton River. The stream meanders through a gently-sloped valley and has a stream gradient of 22 feet/mile. It is flanked by the Teton River to the southeast and by benchlands to the northeast. Stream bottom is interspersed with muck, sand and gravel. Water clarity is good.

The riparian zone is heavily vegetated with native grasses, willows, water birch, chokecherry and cottonwoods. Approximately 1.5 miles of Spring Creek flows through the town of Choteau. Land uses beyond the riparian zone include grazing, hayland and some grain fields. The portion of stream above Choteau flows through the Teton-Spring Creek Bird Preserve.

Land ownership is 100% private with the portion through town involving many owners. Historically, Spring Creek through Choteau was a kids fishing stream and was stocked with catchable rainbow trout by DFWP. Because of its proximity to town, the stream and its banks are popular for wading, picnicing, and other outdoor activities.

Water quality problems are minor. However, due to heavy summer use in the stream portion running through town, littering of the stream and its banks is common. Many people use the area in conjunction with activities in the city park, baseball complex and rodeo grounds.

There are several bridges crossing Spring Creek on county, city and private roads. Access to the stream outside the kids fishing area is somewhat limited. A railroad used to parallel portions of the stream but was recently dismantled. There are several irrigation diversions along the stream. A 16-inch natural gas pipeline crossing Spring Creek about 2 miles above the mouth was replaced in 1987.

**GAME FISH PRESENT:** Brook trout and rainbow trout

**FISHERY:**

Spring Creek is important because it provides a kids fishing area as well as community fishing outside the kids area. The area is also popular for recreational use associated with community activities.

Brook trout are predominant above town but are found in about equal numbers with rainbow trout in the lower portion. A 340-foot section of stream was electrofished in town (Sec. 30B, T24N,R4W) on July 15, 1986. The two-pass method (Leathe 1983) estimated the fish population (brook and rainbow trout combined) to be 21 fish in the 340-foot section. Non-game fish include mottled sculpin, longnose dace and three species of sucker (white, longnose and mountain).

Fishery problems include occasional dewatering in the lower portions for irrigation purposes. During winter, the portion running through Choteau ices up and forces the stream out of its banks.

**WILDLIFE:**

Big game species using the area include white-tailed deer, mule deer, black bear and grizzly bear. The grizzly bear, a threatened species, uses the upper portions of the stream reach during spring and fall. Upland birds include ruffed grouse, sharp-tailed grouse, ring-necked pheasant and Hungarian partridge. Furbearers include beaver, mink, muskrat and fox. Other wildlife include coyote, raccoon, various raptors and waterfowl.

**WETTED PERIMETER:**

The wetted perimeter method could not be used on this stream. As its name implies, this stream is spring-fed and has a relatively stable flow regime, although some fluctuation does occur depending on groundwater supplies and irrigation withdrawals. A base winter flow of 4.5 cfs was measured in December, 1987, and is considered adequate to maintain the fishery.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing trout fishery. The flow will also assist in maintenance of habitat for wildlife species that depend upon the stream and its riparian zone for food, water and shelter. The grizzly bear, a threatened species, is particularly dependent upon the riparian zone of Spring Creek.

#### FLOW REQUEST:

January 1-December 31 -- 4.5 cfs (3,258 A.F./yr.)

Because of the spring creek-like nature of Spring Creek, the wetted perimeter method was not suitable for determining the flow requirement. Therefore, the base flow of the stream is the requested flow.

## Judith River Drainage and Cow Creek<sup>1</sup>

Figure 3-69 is a map which shows the location of the following streams discussed in this section:

Judith River  
So. Fork Judith River  
Lost Fork Judith River  
Middle Fork Judith River  
Yogo Creek

Big Spring Creek  
E. Fork Big Spring Creek  
Beaver Creek  
Cottonwood Creek  
Warm Spring Creek

<sup>1</sup>Cow Creek is a direct tributary to the Missouri River which enters about 40 miles downstream from the Judith River. For convenience it is discussed at the end of this section but can be located on the map in Figure 3-1.

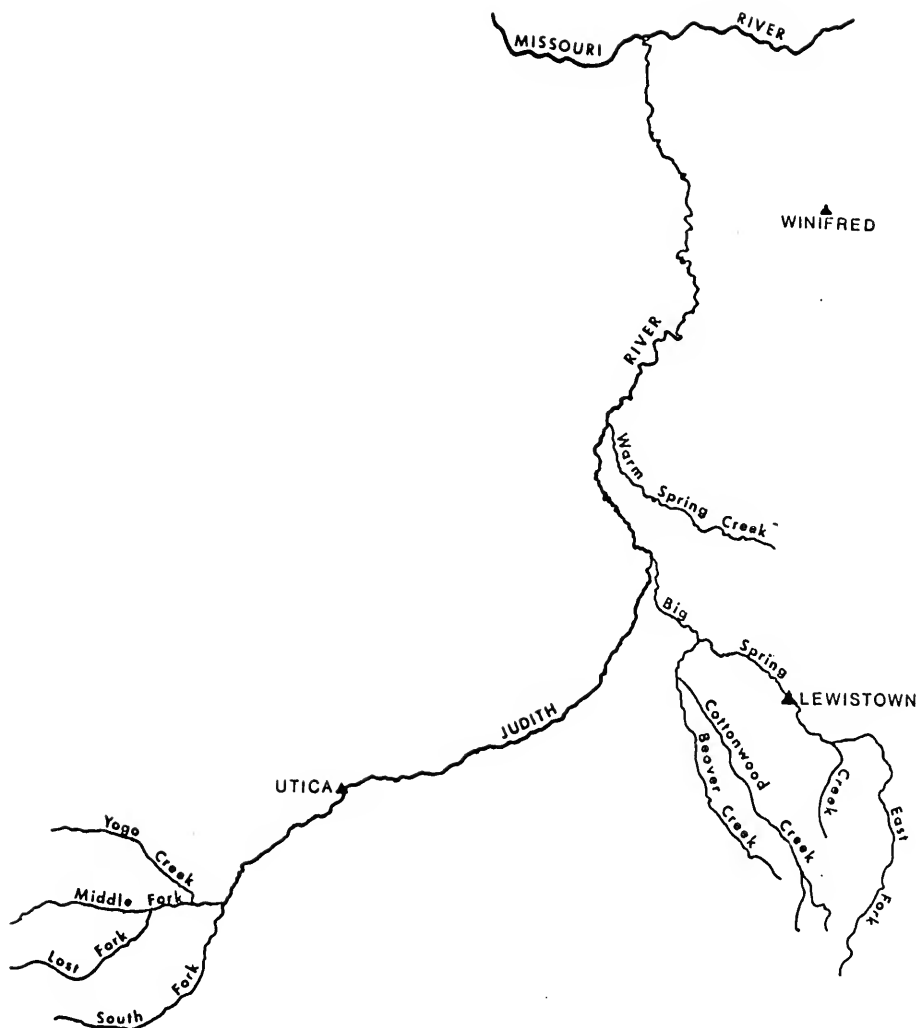


Figure 3-69. Location Map for the Judith River Drainage.

**STREAM NAME:** Judith River

**DESCRIPTION OF THE BASIN:**

The Judith River is the third largest tributary to the Missouri River in the reach between Canyon Ferry and Fort Peck dams. This stream drains an estimated 2,000 square miles of the Little Belt, Big Snowy, Judith and the North and South Moccasin mountains and surrounding lands of central Montana. The Judith flows northward for 129 miles to its confluence with the Missouri River about 50 air miles north of Lewistown. Major tributaries include the Middle, South and Ross Forks, Big Spring and Warm Spring creeks, and Wolf Creek.

The upper Judith River is situated in the mountainous area of the Lewis and Clark National Forest with its tributaries originating at an elevation of about 8,000 feet. The river begins at the confluence of the Middle and South forks and flows within a broad valley through prairie foothills and benchlands. The riparian vegetation, for about half the stream length, consists of a dense willow brushland with adjacent hay meadows. Below this, cottonwoods begin to dominate the overstory along with an undergrowth of willows and rose. The average stream gradient is 30 feet/mile. Channel substrate is comprised mostly of cobbles and gravel with moderate amounts of siltation.

The lower Judith River, from Big Spring Creek to the confluence with the Missouri River (elevation of 2,430 feet) is a prairie stream receiving run-off from adjacent lowlands and surrounding isolated mountain ranges. It follows a narrow river valley through prairie benchlands and rugged breaks. The river valley averages about 1/2 mile wide and becomes progressively more deeply entrenched in a downstream direction. Riparian vegetation consists of a deciduous woodland dominated by an overstory of cottonwoods with a dense shrubby undergrowth of willows, rose and snowberry. The average stream gradient is 12 feet/mile and channel substrate is mostly comprised of cobbles and gravel with increasing amounts of siltation.

Land uses in the Judith River drainage are fairly diverse. Basin wide, timber harvest on forest lands has been moderate, however, the South Fork of the Judith has been, and continues to be, intensively logged. The Forest Service has scheduled timber sales totaling 23.2 million board feet in this drainage over the next 8 years (U.S. Forest Service 1986). Other sales include a total of 11.3 million board feet to be logged from the Wolf Creek drainage over the same 8-year period.

Agricultural uses occur throughout the drainage. Livestock grazing is moderate on the public forest lands of the upper basin and is a major agricultural practice in the lower basin. Nearly all of the land is privately owned and managed for cattle ranching and farming. Hay and some crop lands exist along the river and are more extensive in the upstream areas. Irrigation is also more intensive here, resulting in severe dewatering of the Judith River for several miles. An off-stream storage reservoir, Ackley Lake, located along the upper section of the Judith, stores 6,140 acre-feet and provides irrigation to 1,621 acres (Soil Conservation Service 1977).

Mining activities in the basin date back to the late 1800s. Gold was the primary mineral sought in the Yogo area of the Little Belt Mountains, however, sapphire mining also proved to be commercially successful. Gold mining was also pursued in the North Moccasin and Judith mountains. Presently, only a minimal amount of mining is ongoing in the Judith River Basin. A small open-pit gold mine is presently operating in the North Moccasin Mountains at Kendall and sapphire mining in the Little Belt Mountains has been producing commercial quantities since 1968.

The Judith River is a popular recreation area for fishing, hunting, picnicking, camping, hiking and floating. A considerable portion of the forested land in the upper basin is managed for semi-primitive recreation. The Big Snowy Mountains in the lower basin is presently being considered for wilderness designation.

Access to the river varies along its course. The first 25 miles is paralleled by a county road with several bridge crossings. For the next 45 miles there are only a few roads near the floodplain, but several county roads and highways cross the river at bridges. The remaining 60 miles flow through remote badlands where there are only two access points, including at the confluence with the Missouri. Most of the land adjacent to the stream is privately owned but access is generally allowed with permission.

The USGS recorded stream flows on the Judith River at a gauge near Utica (river mile 99.3) from 1919-75. The mean annual flow for this 56-year period of record was 54.8 cfs.



**STREAM NAME:** Judith River

**STREAM REACH:** #1. From the confluence of the South and Middle forks to Big Spring Creek -- 58 miles

**LOCATION:** Sec. 36B, T13N, R11E to Sec. 26D, T17N, R16E

**GAME FISH PRESENT:** Rainbow trout, brook trout, brown trout, mountain whitefish, cutthroat trout

**FISHERY:**

Brown trout are the predominant game fish found throughout the reach, followed by mountain whitefish and rainbow trout. An excellent population of brook trout exists in the upper portion of the reach where several springs originate and flow into the river. Cutthroat trout are limited to this upper portion where they are present in low numbers. Non-game species include mountain, white and longnose suckers, longnose dace and mottled sculpin.

A population estimate was made in a 2,600-foot section near the upper portion of this reach during October, 1987. Standing crop estimates for brook, rainbow and brown trout are given in Table 3-78. Total trout numbers were estimated at 1,420 trout/mile. This is an abundant fish population for streams typical of this area. The Judith River receives a moderate amount of fishing pressure in this reach.

Table 3-78. Size statistics and standing crop estimates for fish populations in the Judith River sampled about 7 miles below the forks, October 1987.\* (80% confidence intervals in parentheses.)

Species	Number Captured	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brook trout	271	7.2	(3.2-12.9)	0.17	(0.01-0.77)	170 ( $\pm$ 31)
Brown trout	122	8.8	(3.5-20.5)	0.44	(0.01-3.39)	68 ( $\pm$ 14)
Rainbow trout	86	9.8	(3.0-14.9)	0.38	(0.01-1.25)	31 ( $\pm$ 4)
Cutthroat trout	9	6.9	(4.0-10.4)	0.15	(0.01-0.42)	--

\* Fish less than 4 inches were excluded from average size analyses.

#### **WILDLIFE:**

Big game species found within the reach include black bear, elk, mule and white-tailed deer, antelope and mountain lion. Game birds present are ruffed and blue grouse and ring-necked pheasant. Mallard ducks use the springs and beaver ponds throughout the ice-free period. Beaver, mink, muskrat and raccoon are common furbearers.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 413-foot section located near Utica (Sec. 21B, T14N, R13E). Three cross sections were established in two riffles. The WETP program was calibrated to field data collected at flows of 44, 114 and 188 cfs.

The relationship between wetted perimeter and flow from a composite of three riffle cross sections is shown in Figure 3-70. An upper inflection point occurs at an approximate flow of 25 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout populations; to provide adequate flows in lower Judith River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 25 cfs (18,099 A.F./yr.)

# JUDITH RIVER (reach 1)

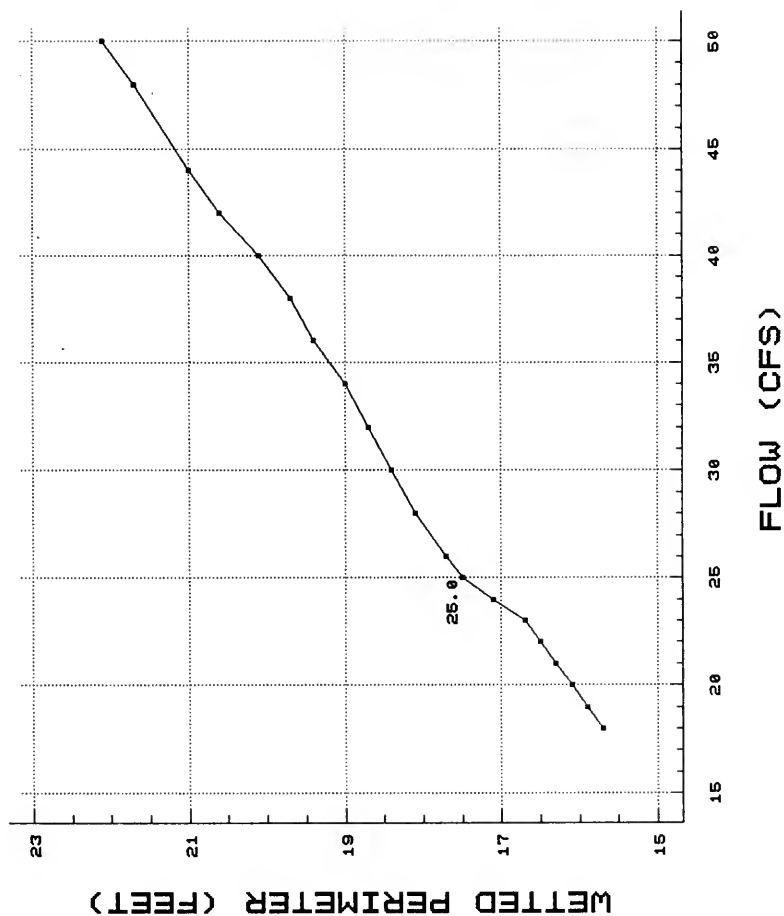


Figure 3-70. The relationship between wetted perimeter and flow for a composite of three riffle cross sections in Reach 1 of the Judith River.

**STREAM NAME:** Judith River

**STREAM REACH:** #2. From the confluence with Big Spring Creek to the confluence with the Missouri River -- 71 miles

**LOCATION:** Sec. 26D, T17N, R16E to Sec. 26B, T23N, R16E

**GAME FISH PRESENT:** Sauger, channel catfish, mountain whitefish, brown trout, rainbow trout, smallmouth bass, walleye, cisco, burbot

**FISHERY:**

This reach of the Judith River is primarily a warmwater fishery where sauger and channel catfish are the most abundant game fish. Coldwater game fish, including rainbow and brown trout and mountain whitefish, also inhabit this reach but occur in low numbers. Cisco, a whitefish species introduced into Fort Peck Reservoir during 1984, has recently been found in fair numbers and is probably the result of upstream movement from the reservoir. Table 3-79 presents game fish survey information collected in 1979 and 1988.

Table 3-79. Size statistics of game fish sampled by electrofishing and gill netting in the lower Judith River during 1979 and 1988.\*

	Number Captured	Average Length (in.)	Range	Average Weight (lb.)	Range
Sauger	38	11.7	(4.7-24.0)	0.77	(0.04-4.75)
Channel catfish	33	20.8	(11.8-32.4)	5.02	(0.62-15.8)
Rainbow trout	7	10.6	(8.3-13.6)	0.48	(0.22-0.78)
Brown trout	4	9.0	(5.6-13.1)	0.31	(0.06-0.72)
Mtn. whitefish	2	10.3	--	0.98	--
Smallmouth bass	3	10.7	(10.0-11.2)	0.72	(0.56-0.85)
Walleye	3	11.0	(10.5-11.6)	0.35	(0.30-0.38)
Burbot	7	14.6	(7.5-20.1)	0.77	(0.18-1.72)
Cisco	30	10.3	(9.2-11.2)	0.32	(0.24-0.42)

\*Fish less than 4 inches were excluded from average size analyses.

Twelve non-game species have been found in the Judith River. A list of these species and their relative abundance is given in Table 3-80.

Table 3-80. Non-game species sampled in the lower Judith River and their relative abundance.

Species	Abundance
Goldeye	C
Carp	C
Western silvery minnow	C
Flathead chub	C
Longnose dace	C
Stonecat	C
Mountain sucker	C
White sucker	U
Longnose sucker	C
River carpsucker	U
Blue sucker	M
Shorthead redhorse	C
Mottled sculpin	U

C = common; U = uncommon; R = rare; M = migrating species

The lower Judith River has a diverse fishery which reflects the variety of habitat conditions present and the transition from a coldwater to a warmwater environment. The lower Judith River receives only a light amount of fishing pressure, most likely due to its remote and fairly inaccessible location.

#### WILDLIFE:

Big game species found along the reach include mule and white-tailed deer. Game birds present are ring-necked pheasant. Beaver, mink, muskrat, and raccoon are common furbearers. Of special significance is the occurrence of several great blue heron rookeries located in the lower 10 miles of this reach.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 2,500-foot section located about 3 miles upstream from the mouth (Sec. 3D, T22N, R16E). Five cross sections were established in two riffles. The WETP program was calibrated to field data collected at flows of 293, 339 and 619 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-71. Lower and upper inflection points occur at approximate flows of 160 and 300 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident game fish populations; to provide flows for the Missouri River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 160 cfs (115,835 A.F./yr.)

The instream flow requested for Reach #2 of the Judith River corresponds to the low level of aquatic habitat potential. Present fish populations are not exceptionally high and, therefore, this stream does not warrant the high level of aquatic habitat protection.

# JUDITH RIVER (reach 2)

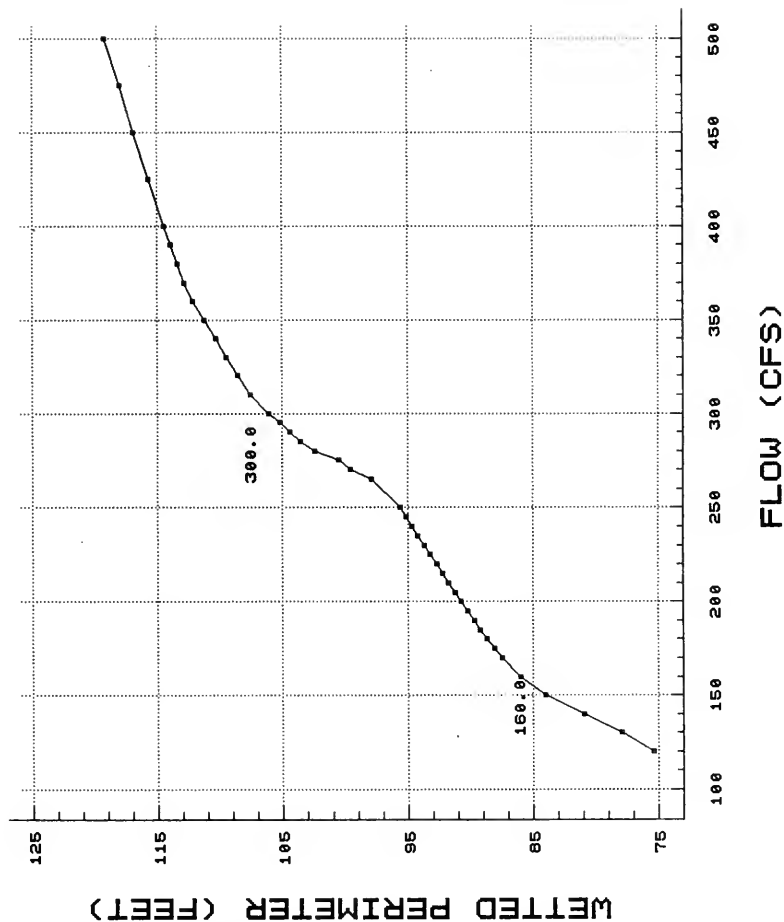


Figure 3-71. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 2 of the Judith River.

**STREAM NAME:** South Fork Judith River

**STREAM REACH:** From the headwaters to the confluence with the Middle Fork -- 18 miles

**LOCATION:** Sec. 7A, T11N, R10E to Sec. 36A, T13N, R11E

**DESCRIPTION OF STREAM REACH:**

The South Fork Judith River is located in Judith Basin County within the boundary of the Lewis and Clark National Forest. It originates at Hoover Springs in the Little Belt Mountains at an elevation near 7,000 feet and flows northeast for 18 miles to its confluence with the Middle Fork at an elevation of about 4,950 feet. Deadhorse Creek, Cabin Creek, Smith Creek and Coral Creek are the primary headwater tributaries to the South Fork.

A USGS gauge on the South Fork near Utica (8 miles upstream from the Middle Fork) operated for 20 years between 1958-79 recorded a mean annual flow of 22.7 cfs.

The landscape of the basin varies from gently to steeply sloping limestone mountains which support montane forests and parklands. At the upper end, the South Fork flows through a gently sloping valley for about 12 miles within a coniferous parkland environment. Willows and grassy meadows border the stream. Downstream from Dry Pole Creek, the South Fork flows for 6 miles through a moderately narrow canyon. The riparian zone is a narrow coniferous woodland with a Douglas fir and ponderosa pine overstory and a shrubby undergrowth of water birch, rose and snowberry. A major forest service gravel road closely parallels the stream through the canyon. The stream gradient is about 48 feet/mile. The channel substrate is typically a boulder, cobble and gravel mix with increasing amounts of bedrock outcroppings and silt deposition towards the lower end. The lower 3 miles of the South Fork characteristically loses water and becomes intermittent during the summer, probably as a result of fracturing of the limestone underlying the stream in this area.

The drainage consists of forested land managed by the Forest Service for timber harvest, livestock grazing and recreation. Timber removal has been fairly intensive and may be a major cause of the high amounts of siltation. The 1986 Forest Plan lists six timber sales totalling 21 million board feet on 2,620 acres that will be offered for sale over the next 10 years.



Fishing, hunting and camping are popular recreational uses within the drainage. Public access to the mainstem and major tributaries is unrestricted and very accessible because of several roads found throughout the basin. Two Forest Service campgrounds and several other undeveloped sites are located along the stream. A few private inholdings and cabins are located near the middle of the drainage.

**GAME FISH PRESENT:** Rainbow trout, brook trout, cutthroat trout and mountain whitefish

#### FISHERY:

Rainbow trout are the most abundant game fish throughout the stream. Brook and cutthroat trout are more abundant in the headwaters and upper tributaries. Sculpin and whitefish are common in the lower end.

A 491-foot section located about 200 yards below the confluence of Dry Pole Creek was sampled during September, 1987 using the two-pass method (Leathe 1983). Standing crop estimates for brook and rainbow trout and mountain whitefish populations are given in Table 3-81. Total trout numbers were estimated to be 354 fish/mile.

Table 3-81. Size statistics and standing crop estimates for fish populations in the South Fork of the Judith River, September, 1987.\* (95% confidence intervals in parentheses.)

Species	Number	Average Length		Average Weight		No. / 1,000 ft.
		(in.)	Range	(lb.)	Range	
Brook trout	2	7.2	(6.5-7.9)	0.15	(0.10-0.20)	4
Rainbow trout	31	6.6	(2.4-10.1)	0.13	(0.04-0.06)	63 ( $\pm 2$ )
Mountain whitefish	12	5.0	(2.9-5.2)	0.04	(0.03-0.06)	24 ( $\pm 3$ )

\* Fish less than 4 inches were excluded from estimate and average size analysis.

The trout habitat in the South Fork has deteriorated over the years because of excessive erosion within the basin. Food production and spawning has been affected due to heavy siltation in the riffle substrates.

This stream receives a substantial amount of fishing pressure for its size. Because of the stream's popularity with local anglers and easy access, the Department usually stocks 500-1,000 catchable rainbow trout annually in the lower couple of miles of the stream.

#### **WILDLIFE:**

Big game species include black bear, mule deer, white-tailed deer and elk. Game birds include ruffed and blue grouse. Beaver, mink and muskrat are the furbearers found along the stream. Beaver are especially numerous in the mid-section and a few mallards and mergansers inhabit the ponded areas.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 169-foot section located 1/2 mile downstream from Indian Hill campground (Sec. 12B, T12N, R11E). Four cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 5.0, 12.6 and 34.1 cfs.

The relationship between wetted perimeter and flow for a composite of the four riffle cross sections is shown in Figure 3-72. An upper inflection point occurs at an approximate flow of 3.5 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout populations and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1 - December 31 -- 3.5 cfs (2,534 A.F./yr.)

# SOUTH FORK JUDITH RIVER

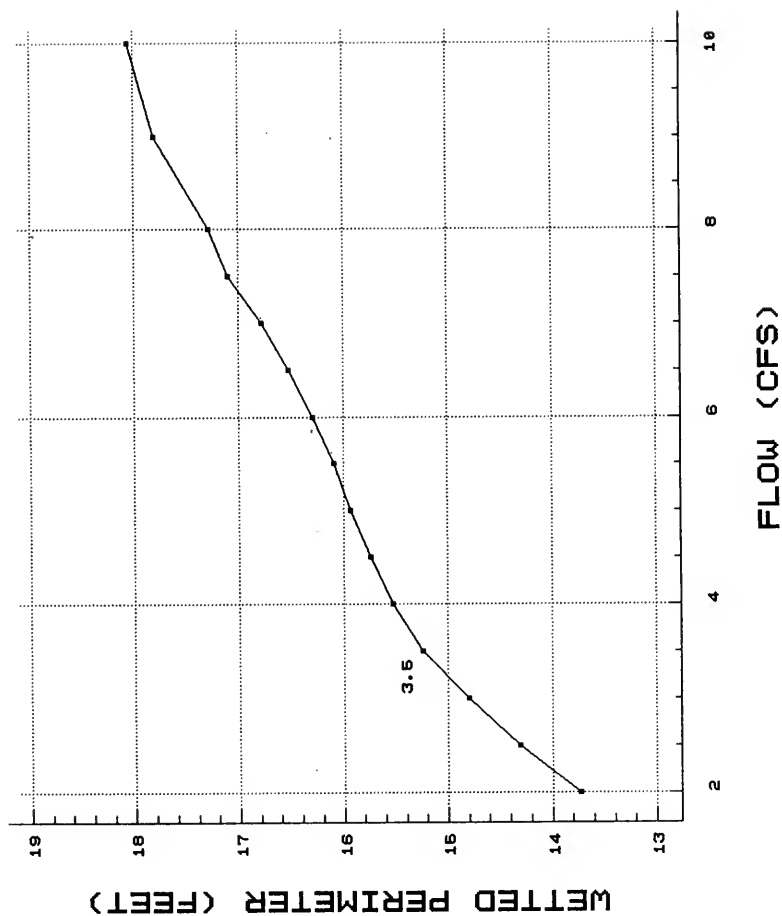


Figure 3-72. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in the South Fork of the Judith River.

**STREAM NAME:** Lost Fork Judith River

**STREAM REACH:** From the confluence of the South and West forks to the confluence with the Middle Fork of the Judith River -- 9 miles

**LOCATION:** Sec. 29D, T12N, R10E to Sec. 31D, T13N, R7E

**DESCRIPTION OF STREAM REACH:**

The Lost Fork Judith River is located in Judith Basin County within the boundary of the Lewis and Clark National Forest. It originates in the Little Belt Mountains at an elevation of 5,990 feet and flows northeast within a moderately to steeply sloping limestone canyon lying amid montane forest and prairie parklands. The reach extends 9 miles to the confluence with the Middle Fork at an elevation of approximately 5,220 feet. Major tributaries are the South Fork and West Fork, Burris and Sand Point creeks.

Although variable, the stream gradient near the study site is about 100 feet/mile. The channel substrate is composed chiefly of cobbles and gravel with considerable amounts of siltation.

The riparian zone consists of a narrow band of timber along steep foothills or a wide gently sloping floodplain, depending upon location within the valley. This zone supports a subalpine woodland predominated by Engelmann spruce and an undergrowth of shrubby cinquefoil. Willows and sedges occupy disturbed sites or where cold-wet soils preclude the prominent vegetation. Beaver activity is common.

The Forest Service manages this area for semi-primitive recreational opportunities. Other land-use practices include livestock grazing and watering and commercial big game outfitting. However, because of the 1985 Sand Point Fire, which burned about 10-15 square miles of the basin, livestock use was temporarily suspended until 1988. Public access is unrestricted even though the stream is located in a remote area. This area offers exceptional aesthetic and recreational qualities and was at one time considered for wilderness designation.

**GAME FISH PRESENT:** Brook trout, rainbow trout, cutthroat trout

## FISHERY:

Brook trout are the predominant game fish, followed by rainbow and cutthroat trout. Cutthroat abundance increases in the headwaters area and the upper tributaries. Mottled sculpin are found throughout the stream's length.

A 500-foot section located 1/2 mile below Burris Creek was sampled during September, 1987 using the two-pass method (Leathe 1983). Standing crop estimates for brook and rainbow trout populations are given in Table 3-82. Total trout numbers were estimated to be 454 fish/mile.

Table 3-82. Size statistics and standing crop estimates for fish populations in the Lost Fork Judith River, September, 1987.\* (95% confidence intervals in parentheses.)

Species	Number	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brook trout	18	6.7	(2.9-9.3)	0.14	(0.04-0.32)	38 ( $\pm$ 5)
Rainbow trout	23	7.8	(5.5-11.4)	0.20	(0.05-0.54)	48 ( $\pm$ 4)

\* Fish less than 4 inches were excluded from estimate and average size analysis.

Prior to the 1985 fire, trampling and over-grazing by livestock limited the fishery. Presently, however, streambank vegetation and pool development have recovered even though substrate remains heavily silted due to erosion of the burned-off areas. Reproduction of rainbow and cutthroat trout has been severely reduced in the fire-impacted portions of the drainage.

The Lost Fork receives light fishing pressure because of its remote location.

## WILDLIFE:

Big game species include black bear, mule deer, white-tailed deer and elk. Elk are especially abundant within this remote drainage. Game birds include ruffed and blue grouse. The beaver is the most noticeable furbearer.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 195-foot section located about 200 yards upstream from the confluence with Sand Point Creek (Sec. 13B, T12N, R10E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 10.3, 17.7 and 45.7 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-73. Lower and upper inflection points occur at approximate flows of 7 and 14 cfs, respectively.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the resident trout populations; to provide flows for the Middle Fork as well as the Judith River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

#### FLOW REQUEST:

January 1 - December 31 -- 14 cfs (10,136 A.F./yr.)

# LOST FORK JUDITH RIVER

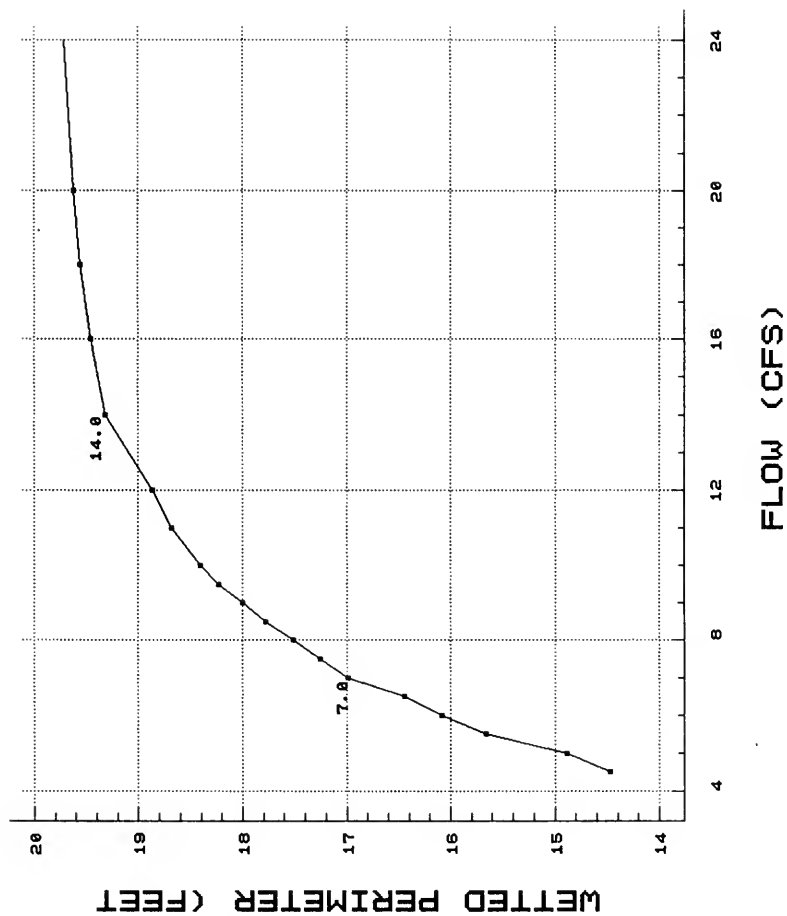


Figure 3-73. The relationship between wetted perimeter and flow from a composite of five riffle cross sections in the Lost Fork Judith River.

**STREAM NAME:** Middle Fork Judith River

**STREAM REACH:** From the headwaters to the confluence with the South Fork -- 14 miles

**LOCATION:** Sec. 2A, T12N, R8E to Sec. 36A, T13N, R11E

**DESCRIPTION OF STREAM REACH:**

The Middle Fork Judith River is located in Judith Basin County within the boundary of the Lewis and Clark National Forest. The headwaters originate in the Kings Hill area of the Little Belt Mountains at an elevation of about 8,000 feet. The mainstem itself originates at the confluence of its 2 main headwater tributaries near the Middle Fork Ranch (elevation 5,650 feet) and flows east for 14 miles to its confluence with the South Fork at an elevation of 4,950 feet. The landscape of the basin varies from gentle to steeply sloping limestone mountains supporting montane forests and parklands.

Cleveland and Harrison creeks form the headwaters. Lost Fork and Yogo Creek are lower main river tributaries.

In the upper basin, the Middle Fork flows for about 8 miles through a moderately sloping valley within a coniferous parkland environment. Willows and grassy meadows border the stream. Downstream, and for the remaining 6 miles, the Middle Fork flows through a very steep and narrow canyon. The riparian zone within the canyon is a forest dominated by Englemann spruce with an understory of rose, snowberry and gooseberry.

Stream gradient is 75 feet/mile. The channel substrate is comprised of gravels and cobbles in the upper reach and by boulders and cobbles, with occasional bedrock outcrops, in the canyon reach. From the confluence with the Lost Fork to the mouth, the channel substrate is heavily silted from the erosional effects of the 10,000-acre forest fire which burned the Lost Fork basin in 1985.

A USGS gauge operated for seven years between 1972-79 at the mouth of the Middle Fork shows the mean annual flow to be 49.3 cfs.

The drainage is forested land managed by the Forest Service for semi-primitive recreational opportunities and livestock grazing. There is one private inholding along 4 miles of the upper reach used for commercial outfitting purposes. This



basin is fairly isolated and access is generally limited to forest trails. The Middle Fork country offers exceptional aesthetic and recreational qualities, and was at one time considered for wilderness designation. Presently, about 5 miles of the lower reach is being studied for "Wild and Scenic designation.

**GAME FISH PRESENT:** Rainbow trout, brook trout, cutthroat trout, brown trout

#### **FISHERY:**

Rainbow trout are the most abundant game fish found throughout the Middle Fork. They are the dominant species found in the canyon area but are less numerous near the mouth. Cutthroat and brook trout are fairly abundant in the headwater streams and brook trout become fairly abundant, once again, near the mouth.

A 510-foot section in the canyon and a 1,480-foot section located 3 miles downstream near the Forest Service ranger station were sampled during the fall of 1987 and 1988. Standing crop estimates based on the two-pass method (Leathe 1983) for brook and rainbow trout populations are given in Table 3-83. Total trout numbers were estimated to be about 300 fish/mile.

Table 3-83. Size statistics and standing crop estimates for fish populations in the Middle Fork Judith River, 1987-88.\* (95% confidence intervals in parentheses.)

#### **USFS Boundary Section, 1987**

<u>Species</u>	Average		Average		No./ 1,000 ft.
	Length (in.)	Range	Weight (lb.)	Range	
Rainbow trout	9.6	(7.2-12.6)	0.39	(0.15-0.85)	5 ( $\pm$ 2)
Brook trout	6.6	(3.4- 9.0)	0.13	(0.01-0.32)	51 ( $\pm$ 19)

# Middle Canyon Section, 1988

Species	Average Length (in.)	Range	Average Weight (lb.)	Range	No. / 1,000 ft.
Rainbow trout	8.2	(5.3-12.3)	--	--	48 (± 22)
Brook trout	7.0	(5.9- 9.8)	--	--	12 <sup>1</sup>

\* Fish less than 4 inches were excluded from estimate and average size analysis.

<sup>1</sup> No brook trout were captured in the 2nd pass through the 510-foot section.

Other species sampled include cutthroat, cutthroat x rainbow hybrid, brown trout and sculpin.

The stream has good pool development and provides sufficient cover, however, the channel substrate remains heavily silted below the Lost Fork confluence as a result of erosion from the 1985 forest fire. Other factors limiting the fishery include livestock trampling and the erosional effects of a Forest Service jeep trail (#437) which fords the Middle Fork at more than 20 locations.

The Middle Fork receives a moderate amount of fishing pressure considering its remote location.

## WILDLIFE:

Big game species include elk, mule deer, white-tailed deer and black bear. Game birds found in the drainage are ruffed and blue grouse. Mink, beaver and muskrat are the common furbearers.

## WETTED PERIMETER:

Cross-sectional data were collected in a 288-foot section located in Sec. 35A, T13N, R11E. Four cross sections were established in two riffles. Two cross sections were not used due to calibration problems. The WETP program was calibrated to field data collected at flows of 20.8, 57.3 and 158.6 cfs.

The relationship between wetted perimeter and flow for a composite of two riffle cross sections is shown in Figure 3-74. An upper inflection point occurs at an approximate flow of 22 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations; to provide flows for the Judith River; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 22 cfs (15,928 A.F./yr.)

# MIDDLE FORK JUDITH RIVER

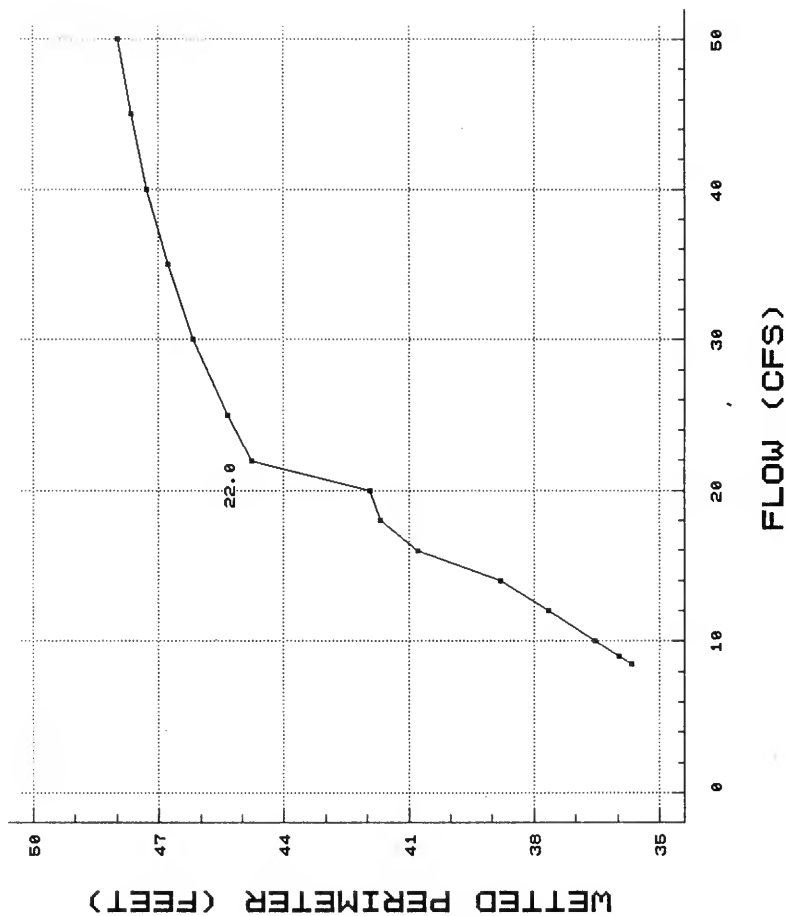


Figure 3-74. The relationship between wetted perimeter and flow for a composite of two riffle cross sections in the Middle Fork of the Judith River.

**STREAM NAME:** Yogo Creek

**STREAM REACH:** From the headwaters to the confluence with the Middle Fork Judith River -- 10 miles

**LOCATION:** Sec. 2D, T13N, R9E to Sec. 34A, T13N, R11E

**DESCRIPTION OF STREAM REACH:**

Yogo Creek is located in Judith Basin County within the boundary of the Lewis and Clark National Forest. It originates in the Little Belt Mountains at an elevation near 8,000 feet and flows southeast for 10 miles to its confluence with the Middle Fork about 2 miles upstream from the forest boundary (elevation 5,040 feet). Elk, Settler and Morris creeks are the tributaries to Yogo Creek. The landscape of the basin consists of moderate to steeply sloping limestone and volcanic mountains which support montane woodlands. Douglas fir and lodgepole pine inhabit the mesic sites while ponderosa pine occupy the drier sites. Some prairie parkland persists at lower elevations and in the eastern portion of the basin.

In the upper basin, Yogo Creek flows for about 5 miles through a moderately sloping valley within a coniferous woodland environment. Englemann spruce dominate the riparian zone along with isolated stands of willows. Downstream from Kelly Coulee, and for the remaining 5 miles, Yogo Creek becomes entrenched within a steep and narrow limestone canyon. The riparian zone in this lower section is a mixed cottonwood-ponderosa pine woodland with an undergrowth of snowberry and rose. The stream gradient is 74 feet/mile. The channel substrate is comprised of cobbles and gravel in the upper section and boulders and cobbles in the lower section. Considerable siltation was noted in the 5-mile lower section. This is probably related to mining activities in the lower and middle basin.

The drainage consists of forested land managed by the Forest Service for timber harvest, mining, livestock grazing and recreation. The 1986 Forest Plan lists timber sales totalling up to 3 million board-feet over an area of about 7,000 acres that will be offered over the next 10 years (U.S. Forest Service 1986).

Private inholding, mostly sapphire mines, are situated along the course of the stream for about 5 miles of the lower reach.

Placer mining for these precious stones is currently sporadic and locally intensive.

Fishing, hunting and camping are popular recreational uses within the drainage. A Forest Service road closely parallels a substantial portion of Yogo Creek and there are spur roads up some of the tributaries. Public access within the basin is unrestricted except for about one mile of the lower reach where a private mining company restricts general access.

**GAME FISH PRESENT:** Brook trout, rainbow trout, cutthroat trout

**FISHERY:**

Brook trout are the most abundant game fish in Yogo Creek, followed by rainbow trout. Cutthroat trout are more abundant in the headwaters area and tributary streams. Sculpins are common in the middle and lower reaches.

A 480-foot section located near Sawmill Gulch was sampled during October, 1987 using the two-pass method (Leathe 1983). Standing crop estimates for brook and rainbow trout populations are given in Table 3-84. Total trout numbers were estimated to be 792 fish/mile.

Table 3-84. Size statistics and standing crop estimates for fish populations in the Sawmill Gulch section of Yogo Creek, 1987.\* (95% confidence intervals in parentheses.)

Species	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brook trout	6.9	(4.0-10.8)	0.10	(0.03-0.44)	129 ( $\pm$ 10)
Rainbow trout	9.2	(4.1-10.3)	0.31	(0.03-0.48)	21 ( $\pm$ 2)

\* Fish less than 4 inches were excluded from estimate and average size analysis.

The stream provides good pool development, bank cover and a favorable substrate. Some siltation occurs in the basin mostly because of placer mining and livestock trampling.

Yogo Creek receives a moderate amount of fishing pressure for its size.

**WILDLIFE:**

Big game species found within the basin include black bear, mule deer, white-tailed deer and elk. Game birds include ruffed and blue grouse. Mink, muskrat and beaver are common furbearers.

**WETTED PERIMETER:**

Cross-sectional data were collected in a 283-foot section located near the mouth (Sec. 34A, T13N, R11E). Five cross sections were established in four riffles. The WETP program was calibrated to field data collected at flows of 2.4, 4.3 and 9.7 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-75. An upper inflection point occurs at an approximate flow of 3 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations; to provide flows for the Judith River; and to assist in the maintenance of habitat for those wildlife species which rely on the stream and its riparian zone for food, water and security.

**FLOW REQUEST:**

January 1-December 31 -- 3 cfs (2,172 A.F./yr.)

# YOGO CREEK

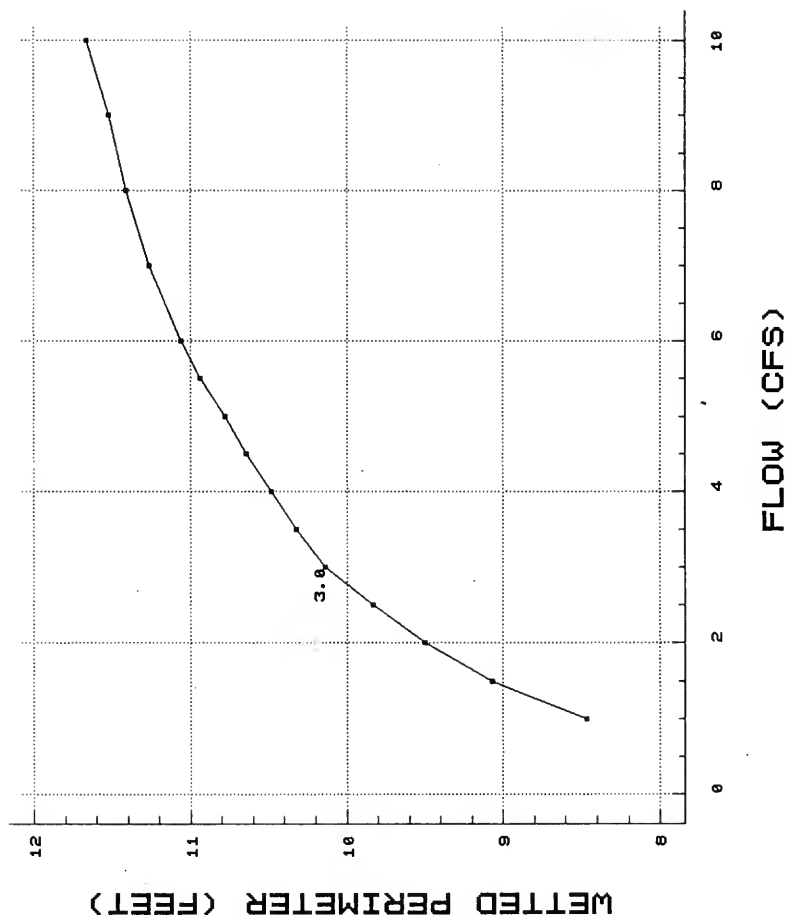


Figure 3-75. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Yogo Creek.



**STREAM NAME:** Big Spring Creek

**DESCRIPTION OF THE BASIN:**

The Big Spring Creek watershed lies in the south central part of Fergus County in central Montana. The watershed averages about 7 miles in width, is about 44 miles long and includes about 96,000 acres. It extends south from Lewistown for approximately 21 miles to drain the north slopes of the Big Snowy Mountains. The Big Snowy Mountain Range is a sinuous limestone ridge having an elevation of 8,000 feet. Elevations within the watershed vary from 8,730 feet at Greathouse Peak to 3,435 feet at the confluence of Big Spring Creek and the Judith River. Topography within the watershed includes mountains, rolling foothills, plains and floodplain areas.

Big Spring Creek is one of the largest spring-fed streams in the state. The majority of flow originates from a large spring located near the Big Spring State Fish Hatchery approximately 9 miles southeast of Lewistown. The water originates in the Snowy Mountains by percolation into bedrock. Artesian water from these subterranean flows comes to the surface to form the Big Springs. USGS records show the flow near this site to be very stable, averaging 107 cfs for the period of record (1932-57) (U.S. Geological Survey 1957). The City of Lewistown, with a population of about 9,000, diverts water for municipal use above this gauge. The base flow determined at a USGS gauging station located above Lewistown from periodic readings made between 1969 and 1972 was 134 cfs. A second USGS gauging station below Lewistown periodically recorded flows from 1969 to 1975. Flows ranged from 138 to 1,000 cfs, with a base flow of 124-142 cfs. A 100-year flood event occurred in 1975 which produced flows of 2,200 cfs (Decker-Hess 1986).

Tributaries which contribute additional flow below the spring include East Fork, Pike, Big and Little Casino, Boyd and Cottonwood creeks.

Big Spring Creek flows approximately 32 miles from the spring to its confluence with the Judith River. Average channel width ranges from 40 to 50 feet and mean depth ranges between 18 and 24 inches. Stream gradient averages 20.5 feet per mile and the floodplain has an average width of 1,150 feet.

The stream channel upstream from Cottonwood Creek is in relatively good condition with its stable banks and a well developed riparian zone. Channel substrate is primarily sand and gravel with a limited amount of cobbles. Bank vegetation consists of willows, water birch, hawthorne, wild rose, grasses and forbs.

The channel downstream from Cottonwood Creek is more unstable, with considerable channel migration, sloughing banks and greater sediment deposition. Substrate types range from sand to small cobbles. Much of the bottomland is covered with dense stands of cottonwoods, willows, water birch and hawthorne. Because of the unstable floodplain in this reach, there is little agricultural development.

The entire Big Spring Creek drainage is in private ownership. Access is limited, particularly on the lower 11 miles. The Montana Department of Fish, Wildlife and Parks owns the property where the main spring source is located. It also owns two fishing access sites on Big Spring Creek, one just upstream from Lewistown and one about 3 miles downstream from Lewistown. The Department also has a recreational easement on about 1 mile of creek between the fish hatchery and Lewistown.

Cattle and hay production are the major land uses in the drainage. In addition to the state fish hatchery, three private hatcheries use Big Spring Creek water to raise trout for commercial purposes. Big Spring Creek flows through the city of Lewistown which diverts water for municipal use. A number of permanent homes have been built along the stream channel in several areas upstream from Lewistown. Two ditches and several pump systems divert water from the stream near Lewistown for irrigation purposes.

The Big Spring Creek drainage has been impacted by a number of activities. Because of a history of flash flooding, flood control dams have been constructed on the four major tributaries located upstream from Lewistown. These dams have altered the natural flow during flood periods from flash floods of short duration to bank full flows extending from 4 to 6 weeks. These extended high flows have significantly increased erosion rates within the watershed.

Several channel alterations on the outskirts of Lewistown have caused extensive erosion which resulted in the expenditure of nearly \$1 million in public funds to correct. Lewistown's primary sewage treatment plant and a sawmill both discharge effluents into Big Spring Creek.

**STREAM NAME:** Big Spring Creek

**STREAM REACH:** #1. From the state fish hatchery to the confluence with Cottonwood Creek -- 23.7 miles

**LOCATION:** Sec. 5, T14N, R19E to Sec. 28, T16N, R17E

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout, mountain whitefish

**FISHERY:**

Big Spring Creek is high in dissolved solids, exceptionally productive, and for its size, rated as one of Montana's finest fishing waters. The creek is considered by local sportsmen and tourists to be the most important trout stream in central Montana. It has produced many fish over 10 pounds and several between 18 and 20 pounds.

Rainbow and brown trout are the major game species in this reach, with rainbow making up a majority of the population. A few brook trout and whitefish are also found.

Electrofishing surveys have been conducted on two study sections in this reach since 1979. The Tresch section is 0.83 miles long and is located immediately downstream from the city of Lewistown. The Burleigh section is 1.11 miles long and is located 4 miles upstream from Lewistown. Tables 3-85 and 3-86 show annual rainbow and brown trout population estimates for these two sections for the period 1979-86.

Table 3-85. Number of rainbow trout per mile by size group in the Tresch and Burleigh electrofishing sections on Big Spring Creek, 1979 - 1986.<sup>1</sup>

Rainbow trout per mile

Sample Year	<u>5-10 inches</u>	<u>10-15 inches</u>		<u>15 inches &amp; longer</u>	
	Tresch	Tresch	Burleigh	Tresch	Burleigh
1986	1530	1547	1404	87	21
1985	--	--	--	--	--
1984	1136	1918	692	234	34
1983	1487	2114	389	137	0
1982	--	--	428	--	30
1981	1666	867	330	245	23
1980	811	849	428	236	19
1979	506	549	172	22	4

<sup>1</sup> From Leathe and Hill (1987).

Table 3-86. Number of brown trout per mile by size group in the Tresch and Burleigh electrofishing sections on Big Spring Creek, 1979 - 1986.<sup>1</sup>

Brown trout per mile

Sample Year	<u>10-15 inches</u>		<u>15 inches &amp; longer</u>	
	Tresch	Burleigh	Tresch	Burleigh
1986	275	20	71	61
1985	--	--	--	--
1984	288	20	125	39
1983	222	7	113	28
1982	--	7	--	60
1981	312	5	111	60
1980	339	5	121	79
1979	175	5	34	40

<sup>1</sup> From Leathe and Hill (1987).

Nongame fish species found in this reach include mottled sculpin, longnose dace, longnose sucker, white sucker, mountain sucker, shorthead redhorse, carp and lake chub.

Big Spring Creek receives a substantial amount of angler use. The 1982-86 mail survey of Montana anglers estimated there was an average of about 11,000 angler-days of use per year on this reach of the creek (McFarland 1989). The majority of use is by bank fishermen, however, Big Spring Creek does receive a considerable amount of floating use. Most floating activity is related to swimming, canoeing, duck hunting, and bird watching. Floating the stream with inner tubes has become popular during the warm months.

#### WILDLIFE:

The Big Spring Creek drainage supports a large population of white-tailed and mule deer. Other big game species inhabiting the watershed include elk, black bear, mountain goat and mountain lion. Furbearers include mink, muskrat, beaver, fox, bobcat, coyote, and raccoon. Upland game birds include blue, ruffed and sharp-tailed grouse, ring-necked pheasant, Hungarian partridge, and wild turkey. The open water throughout the winter attracts large numbers of ducks, which in turn, attract bald eagles to the watershed. A great blue heron rookery is located along the stream near Lewistown. The area also supports a wide variety of nongame wildlife, birds of prey, and songbirds.

Waterfowl use is heavy. Wintering mallards make considerable use of the open water on Big Spring Creek. Common mergansers, Canada geese, blue-winged teal, and goldeye are also found along the creek.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a riffle section immediately upstream from Lewistown (Sec. 25, T15N, R18E). Six cross sections were established. The WETP computer program was calibrated to field data collected at flows of 131, 217 and 314 cfs.

The relationship between wetted perimeter and flow for a composite of the six riffle cross sections is shown in Figure 3-76. Lower and upper inflection points occur at approximate flows of 60 and 110 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the high quality wild trout fishery of Big Spring Creek at the existing level and to protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 110 cfs (79,636 A.F./yr.)

# BIG SPRING CREEK (reach 1)

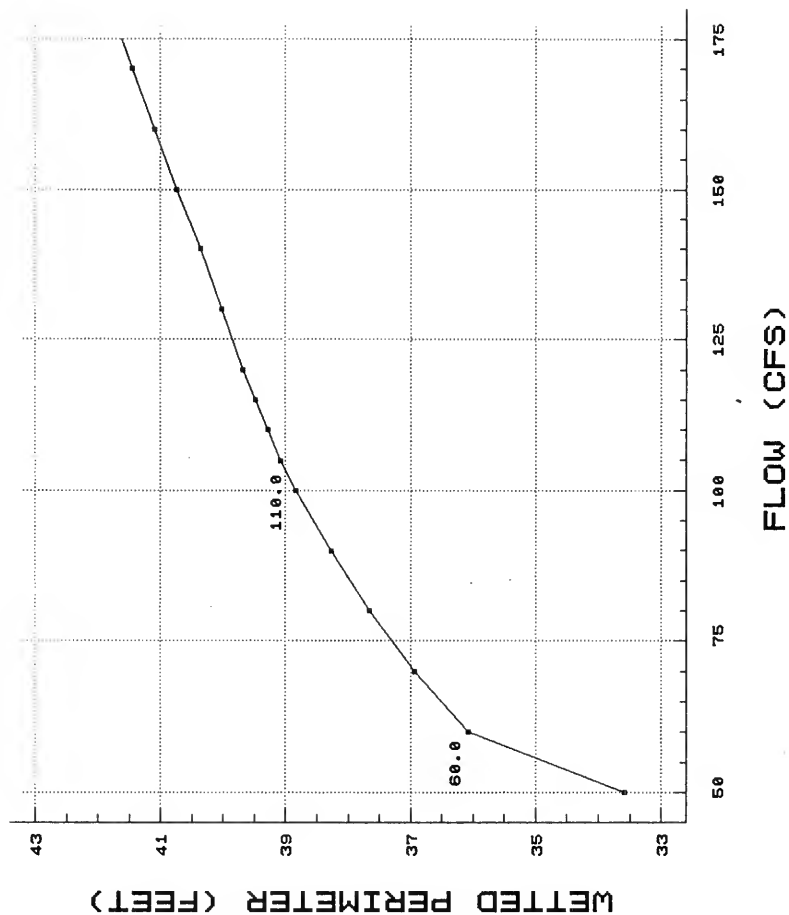


Figure 3-76. The relationship between wetted perimeter and flow for a composite of six riffle cross sections in Reach 1 of Big Spring Creek.

**STREAM NAME:** Big Spring Creek

**STREAM REACH:** #2. From the confluence of Cottonwood Creek to the mouth -- 8.2 miles

**LOCATION:** Sec. 28, T16N, R17E to Sec. 26, T17N, R16E

**GAME FISH PRESENT:** Brown trout, rainbow trout, mountain whitefish, sauger

**FISHERY:**

Limited information exists on fish populations within this reach. A population estimate conducted in 1979 on a 2-mile section of stream just upstream from the mouth determined there were 323 age II and older rainbow and 200 age I and older brown trout in this section. Whitefish were found to be more abundant than trout.

Sauger are also found in this reach. They move into the lower section of Big Spring Creek from the Judith River, probably to spawn. Nongame species found in this reach include mottled sculpin, longnose dace, longnose, white and mountain suckers, shorthead redhorse, carp, lake chub and goldeye.

Fishing pressure on this reach is much less than for the upper reach, but still substantial. Between 1982-86 this reach supported an average annual use of about 3,200 angler-days (McFarland 1989).

**WILDLIFE:**

Major big game species found along this reach are mule and white-tailed deer. Furbearers include mink, muskrat, beaver, fox, bobcat, coyote and raccoon. Upland game birds include blue, ruffed and sharp-tailed grouse, Hungarian partridge, ring-necked pheasant and wild turkey. Open water through the winter attracts large numbers of ducks which, in turn, attract bald eagles to the area. Numerous raptors and other nongame animals and birds also inhabit this section of the watershed.

Waterfowl use is substantial. Wintering mallards make considerable use of this open water. Other waterfowl species found along the stream include common mergansers, Canada geese, blue-winged teal, and goldeye.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a riffle section immediately downstream from the mouth of Cottonwood Creek (Sec. 28, T16N, R17E). Five cross sections were established. The WETP computer program was calibrated to field data collected at flows of 159, 385 and 564 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-77. An upper inflection point occurs at an approximate flow of 100 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the high quality wild trout fishery of Big Spring Creek at the existing level; to maintain spawning flows for sauger and to protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 100 cfs (72,397 A.F./yr.)



# BIG SPRING CREEK (reach 2)

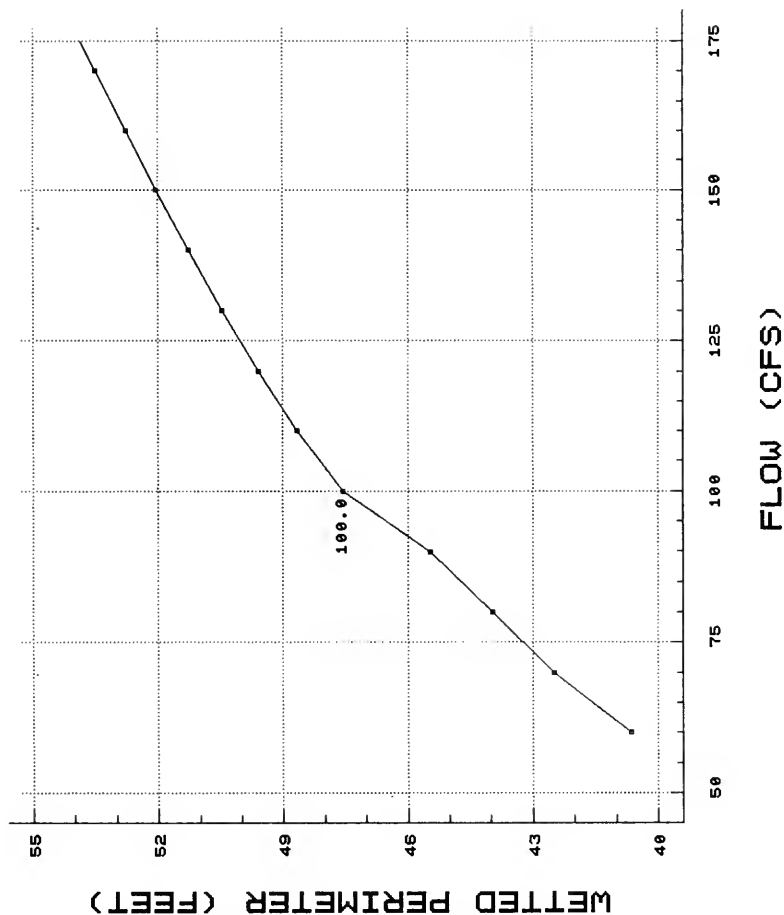


Figure 3-77. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 2 of Big Spring Creek.

**STREAM NAME:** East Fork Big Spring Creek

**STREAM REACH:** From its headwaters to its Confluence with Big Spring Creek -- 24 miles

**LOCATION:** Sec. 29A, T12N, R19E to Sec. 31A, T15N, R19E

**DESCRIPTION OF STREAM REACH:**

The East Fork of Big Spring Creek is located in Fergus County. It originates at an elevation of about 8,000 feet on the northern flank of the Big Snowy Mountains. The stream flows north for about 20 miles. It then turns east for the remaining 4 miles to its confluence with Big Spring Creek, 5 miles southeast of Lewistown (elevation of 4,070 feet).

The Middle Fork, Buffalo Creek and Canyon Creek are the primary tributaries to the East Fork of Big Spring Creek.

The upper quarter of the basin occupies steep subalpine and montane forested mountain slopes in the Lewis and Clark National Forest. The remaining portion of the basin lies within mountain foothills. The sub-humid environment of these foothills supports parkland vegetation of Douglas fir, aspen, hawthorn, snowberry and bunch grass.

For most of its length, the stream occupies a valley about 1/4 mile wide bordered by steep slopes. The East Fork Reservoir, a 226-acre flood control impoundment, is located in the lower basin 6 miles above the mouth. During the base flow period, inflows and outflows are about equal. This impoundment appears to have harmful effects on the East Fork by causing elevated downstream water temperatures due to release of surface water from the reservoir. The reservoir also acts as a sediment trap. Therefore, the released water is clear and is probably the cause of the accelerated downcutting of the stream channel.

The riparian vegetation of the floodplain varies within the reach. In the upper quarter of the basin, spruce and Douglas fir comprise the overstory, with an undergrowth of willows and rose. Near the lower reaches, the riparian vegetation consists of water birch, red osier dogwood and pockets of willows interspersed among grasses and sedges. Hay meadows and lush pasture lands occupy the adjacent floodplain above

the riparian zone. Below the dam, the stream maintains a meandering course with a gradient of 35 feet/mile. The channel substrate is composed of cobbles and gravel with moderate siltation.

Land uses include livestock grazing and hay production. Coal and gypsum mining have occurred in the past but there are no longer any active mines. The upper basin is managed by the Forest Service primarily for recreation, however, adjacent private land prevents direct access to those public lands. Secondary Highway 238 and a county road follow the stream in the foothill area. All land adjacent to the creek is privately owned and fishing access is usually granted with permission. The East Fork Reservoir has recreational development for boating, fishing, picnicking and camping. The DFWP regularly stocks this reservoir with rainbow or brown trout.

**GAME FISH PRESENT:** Rainbow trout, brown trout, brook trout

**FISHERY:**

Rainbow trout are the most common game fish, followed by brown and brook trout. Rainbow and brown trout up to 11 inches and brook trout up to 10 inches in length are present in the stream according to 1987 DFWP electrofishing data. Nongame species include longnose, white and mountain suckers, longnose dace, fathead minnow and mottled sculpin.

**WILDLIFE:**

Big game species found within the basin include elk, mule and white-tailed deer and black bear. Game birds present are ring-necked pheasant and ruffed and blue grouse. Beaver, mink and muskrat are common furbearers.

**WETTED PERIMETER:**

Cross-sectional data were collected in a 336-foot section located about 1.5 miles upstream from the mouth (Sec. 32A, T15N, R19E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 5.1 and 34.4 cfs.

The relationship between the wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-78. An upper inflection point occurs at an approximate flow of 7.5 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations; to provide flows for Big Spring Creek; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 7.5 cfs (5,430 A.F./yr.)

# EAST FORK BIG SPRING CREEK

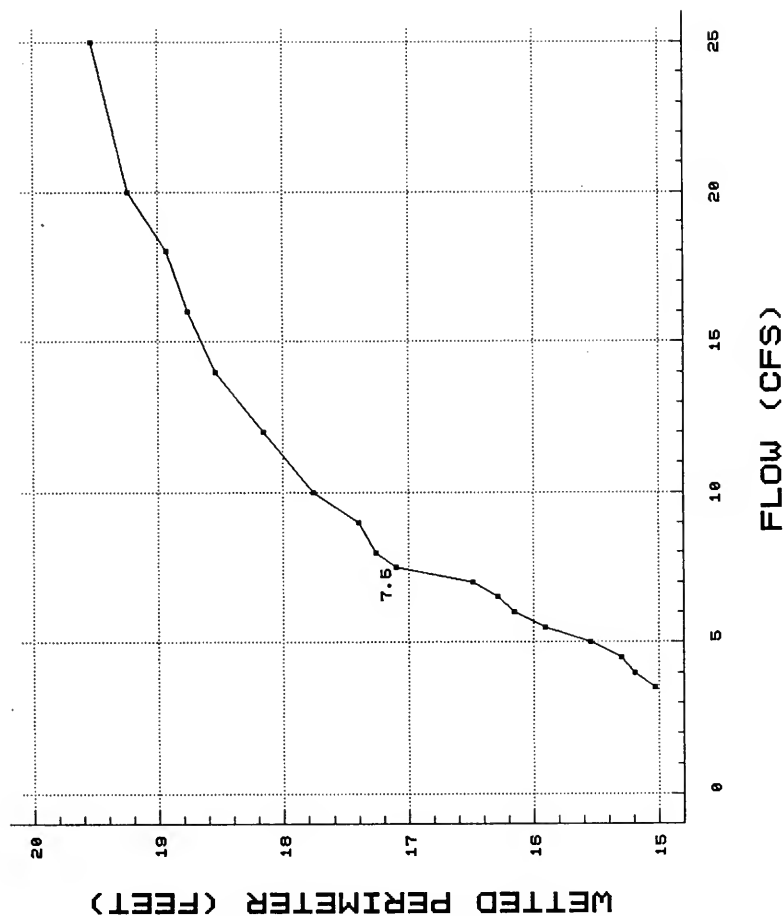


Figure 3-78. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in East Fork Big Spring Creek.

**STREAM NAME:** Beaver Creek

**STREAM REACH:** From the West Fork Beaver Creek to the confluence with Cottonwood Creek -- 13.2 miles

**LOCATION:** Sec. 22A, T14N, R17E to Sec. 8A, T15N, R17E

**DESCRIPTION OF STREAM REACH:**

Beaver Creek, located in Fergus County, originates east of Pratt Hill at an elevation of 5,500 feet and drains the foothill area north of the Big Snowy Mountains. The stream flows north and receives water from several small springs. Its confluence with Cottonwood Creek is located at "The Point" 4 miles southwest of Hanover (elevation 3,785 feet). The Middle Fork and West Fork are the primary tributaries.

The basin consists of gently to steeply sloping sedimentary foothills and gently dipping benchlands. The basins sub-humid environment supports mostly aspen, rose, snowberry and bunchgrass vegetation.

The 13.2-mile stream reach occupies a 1/2 mile wide valley flanked by steep 100-300 foot benches. Hay meadows and pasture lands occupy the valley floor. The riparian zone consists of segments of willow brushland and meadows of grasses and sedges. The stream maintains a meandering course with a gradient of 37 feet/mile. Channel substrates are cobbles and gravel which become heavily silted in downstream areas.

Land uses include livestock grazing and hay and grain production. A good county road parallels Beaver Creek over its entire length. Highway 87, a railroad and a few county roads cross the creek and provide access points. All land bordering Beaver Creek in the stream reach is under private ownership, but fishing access is usually permitted.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout, mountain whitefish

## **FISHERY:**

Brook trout are the most abundant game fish, with the largest numbers occurring in the upper portion of the reach. Brown trout numbers are low but individuals reach a length of up to 17 inches and over 2 pounds in weight. Rainbow trout are mostly hatchery fish planted annually in the Glengarry area. Non-game species include longnose and white suckers, longnose dace and mottled sculpins.

The lower portion of Beaver Creek supports only a marginal coldwater fishery. There is a good potential for developing a smallmouth bass population.

Factors limiting the fishery are mostly man-caused. They include livestock trampling of stream banks, reduced bank cover, excessive siltation and elevated water temperatures. Siltation of the stream substrates probably limits reproduction. Fishing pressure on Beaver Creek is light.

## **WILDLIFE:**

Big game species found within the basin include mule and white-tailed deer. Game birds present are ring-necked pheasant and Hungarian partridge. Mallard ducks utilize the many beaver ponds along the stream. Common furbearers are beaver, mink, muskrat and raccoon.

## **WETTED PERIMETER:**

Cross-sectional data were collected in a 500-foot section located about 3/4 mile downstream from the Highway 87 bridge (Sec. 20A, T15N, R17E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 6.4, 11.4 and 18.2 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-79. An upper inflection point occurs at an approximate flow of 5 cfs.

## **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident fish populations and to insure the opportunity for improving the fishery through introductions of smallmouth bass; to maintain the recreational value of Beaver Creek; to provide flows to

Cottonwood and Big Spring creeks; and to assist in the maintenance of habitat for those wildlife species which rely on the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 5 cfs (3,620 A.F./yr.)



# BEAVER CREEK

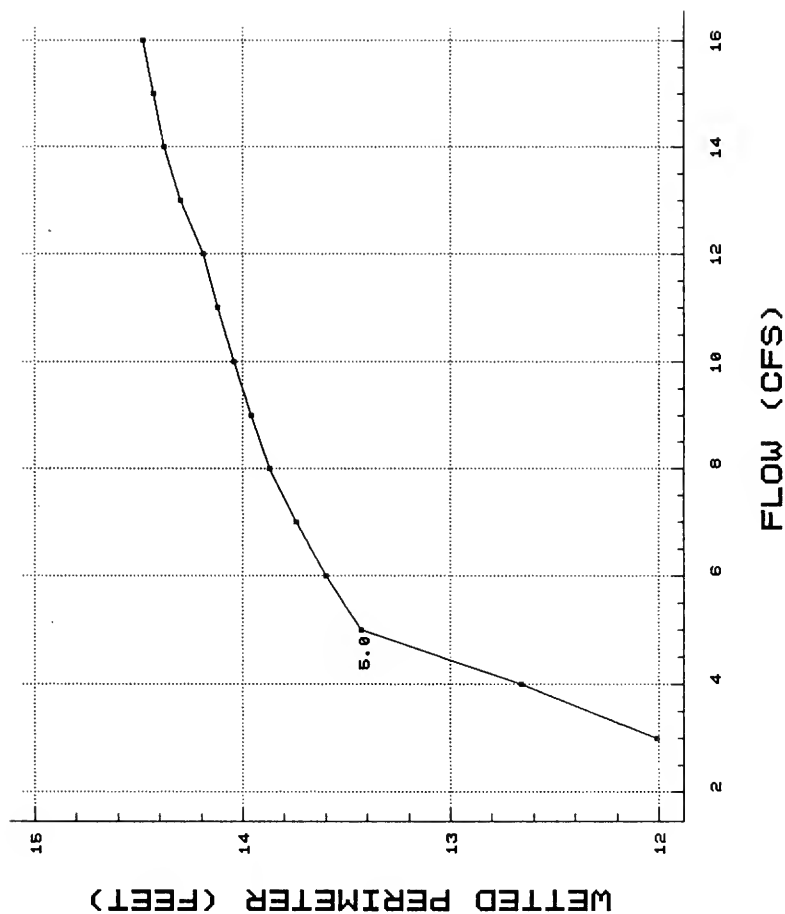


Figure 3-79. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Beaver Creek.

**STREAM NAME:** Cottonwood Creek

**STREAM REACH:** From the Spring Branch of Cottonwood Creek near Glengarry to the confluence with Big Spring Creek -  
- 14.3 miles

**LOCATION:** Sec. 36C, T15N, R17E to Sec. 28A, T16N, R17E

**DESCRIPTION OF STREAM REACH:**

Cottonwood Creek is located in Fergus County. It originates at an elevation of 8,000 feet on the northern flank of the Big Snowy Mountains in steep subalpine and montane forests. Beaver Creek is the primary tributary to Cottonwood Creek. Lesser tributaries are the East and West forks.

The stream flows northwesterly from the mountains onto gently to steeply sloping foothills and benchlands. The lower basin's sub-humid environment supports mostly aspen, rose, snowberry and bunchgrass vegetation. Several small springs contribute water to Cottonwood Creek in the lower basin. The confluence with Big Spring Creek occurs 1/2 mile west of Hanover (elevation 3,600 feet).

The upstream boundary of the reach is located below the major recharge area of the Spring Branch of Cottonwood Creek. From here, Cottonwood Creek meanders through a broad valley, about 3/4 mile wide, flanked by steep, 100-foot high benches. Riparian vegetation consists of a cottonwood dominated woodland with willows, chokecherry, rose and other shrubs comprising the undergrowth. Stream gradient is 38 feet/mile. The channel substrate is composed of small boulders and cobbles.

Land uses in this prairie zone include livestock grazing and hay and grain production. A good county road parallels the creek over its entire length. Highway 87, a railroad and a few county roads cross the creek and provide access points. All land bordering Cottonwood Creek in the stream reach is under private ownership, but fishing access is allowed in most places with permission.

**GAME FISH PRESENT:** Brown trout, brook trout, rainbow trout

## FISHERY:

Brown trout are the predominant game fish, followed by brook and rainbow trout. Most of the rainbow trout are hatchery fish planted annually in the Glengarry area. Non-game species include longnose and white suckers, longnose dace and mottled sculpins.

A 544-foot section located 1/2 mile northwest of Highway 87 was sampled in October, 1987 using the two-pass method (Leathe 1983). Standing crop estimates for brown, brook and rainbow trout are given in Table 3-87. Total trout numbers were estimated to be 485 fish/mile. Cottonwood Creek also sustains a fall spawning migration of brown trout from lower Big Spring Creek.

Table 3-87. Size statistics and standing crop estimates for fish populations in Cottonwood Creek, Highway 87 area, October 1987.\* (95% confidence intervals in parentheses.)

Species	Number	Average Length (in.)	Range	(lb.)	Average Weight Range	No./ 1,000 ft.
Brown trout	27	8.4	(3.2-14.5)	0.35	(0.01-1.12)	51 (± 5)
Brook trout	14	8.1	(4.0-10.8)	0.22	(0.02-0.43)	26 (± 3)
Rainbow trout	8	9.2	(8.1-10.4)	0.31	(0.22-0.35)	15 (± 2)

\* Fish less than 4 inches were excluded from estimate and average size analyses.

Natural factors limiting the fishery are periodic low stream flows and elevated water temperatures. Livestock trampling and sedimentation caused by poor agriculture practices limit the fishery as well. This stream receives light fishing pressure.

## WILDLIFE:

Big game species found within the basin include elk, mule and white-tailed deer. Game birds include pheasant, Hungarian partridge, ruffed and blue grouse. Mallard ducks use the many beaver ponds found in the floodplain. Beaver mink, muskrat and raccoon are the common furbearers.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 300-foot section located about 1/2 mile downstream from the Highway 87 bridge (Sec. 15C, T15N, R18E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 5.2, 13.2 and 48.2 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-80. An upper inflection point occurs at an approximate flow of 4.5 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout populations; to maintain spawning and rearing habitat for migrant brown trout; to provide flows for Big Spring Creek and the Judith River; and to assist in the maintenance of habitat for those wildlife species which rely on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 4.5 cfs (3,258 A.F./yr.)

# COTTONWOOD CREEK

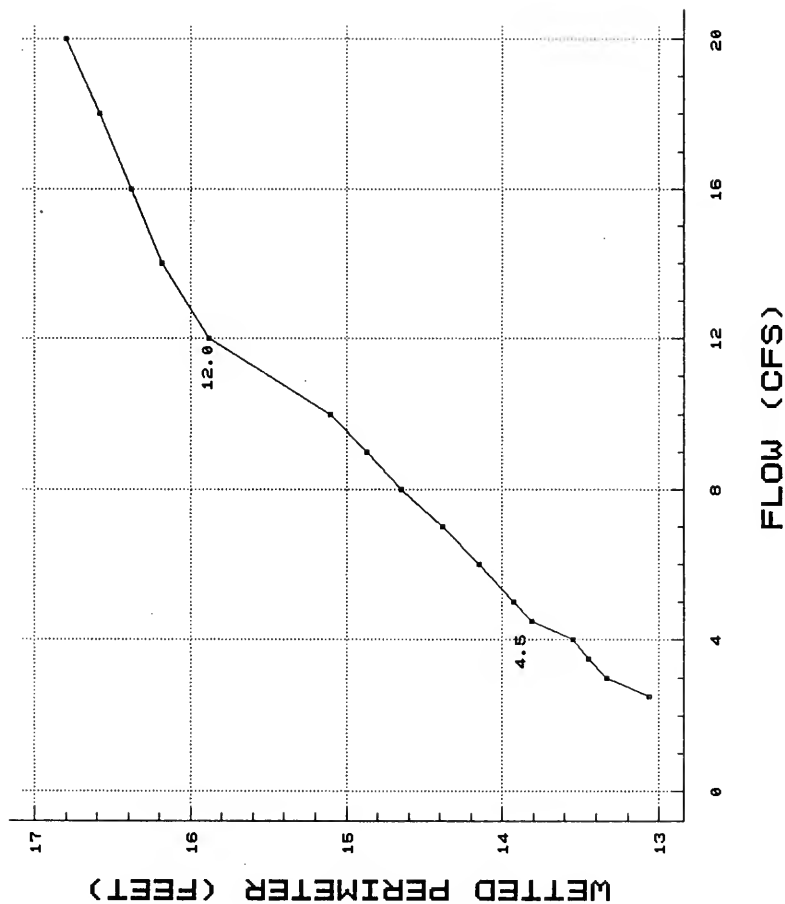


Figure 3-80. The relationship between wetted perimeter and flow for a composite of five rifle cross sections in Cottonwood Creek.

**STREAM NAME:** Warm Spring Creek

**STREAM REACH:** From the springs to the confluence with the Judith River -- 28 miles

**LOCATION:** Sec. 19D, T17N, R18E to Sec. 8D, T18N, 16E

**DESCRIPTION OF STREAM REACH:**

Warm Spring Creek originates from a first-magnitude spring located in Fergus County (elevation 3,750 feet). Although the headwaters are in the Judith Mountains, the creek does not become a perennial stream until it reaches the springs about 12 miles north of Lewistown. From the springs, the creek flows for 28 miles in a northwesterly direction until joining the Judith River 7 miles north of Danvers (elevation 3,100 feet). There are no perennial tributaries to Warm Spring Creek.

Warm Spring discharges groundwater originating from parts of the North Moccasin, South Moccasin, and Judith mountains (Feltis 1973). The spring emerges from artesian aquifers in the Madison limestone formation over 1,000 feet beneath the surface. Because of this deep subterranean origin, the water temperature is elevated well above that which might be expected. Baldes (1970) measured the spring water at a constant temperature of nearly 68°F.

The flow of Warm Spring Creek just downstream from the spring ranged between 136-270 cfs during the 1968-71 water years. The discharge of the spring is about 125 cfs (Decker-Hess 1986).

Warm Spring Creek flows through prairie benchland. The floodplain is fairly narrow and the lower 20 miles of stream become deeply entrenched, with steep benches rising over 100 feet above the stream. Riparian vegetation consists of a deciduous shrubland with willows, water birch, hawthorn and chokecherry comprising the overstory. Parcels of grasslands and hay meadows also border the stream throughout the reach. The stream gradient is about 20 feet/mile. The channel substrate is composed mostly of small cobbles and gravel. Aquatic vegetation is prevalent throughout the creek during the summer months.

Nearly all of the land along Warm Spring Creek is privately owned. Lands adjacent to the stream are managed for hay production and livestock grazing. A small hydroelectric facility which would have dewatered a portion of the stream

was proposed during 1981. However, the project has not been built (Poore 1982). More recently, a sturgeon hatchery and farm have been proposed on Warm Spring Creek at the upper end of the reach. This facility would divert 56 cfs from the creek for initial operation of the system (Montana Department of Fish, Wildlife and Parks 1988).

Highway 81 parallels the upper 20 miles of Warm Spring Creek and provides good access for anglers. Most landowners along the creek will allow fishing with permission.

**GAME FISH PRESENT:** Rainbow trout, brown trout, smallmouth bass, sauger, brook trout, channel catfish

#### **FISHERY:**

Rainbow trout are the most abundant game fish found in Warm Spring Creek. Water temperatures are probably above the tolerance levels for rainbow trout spawning and little evidence of successful reproduction has been found. Presently, 6,000 catchable rainbow trout are stocked annually. Smallmouth bass were introduced during 1973 and annual stocking continued until 1977. Although smallmouth bass have been reported in the angler's creel, few have been captured while electrofishing, probably because of poor sampling efficiencies. Brown trout and sauger are generally found in low numbers throughout the study reach. Other species occurring in Warm Spring Creek include brook trout, channel catfish, common carp, and longnose, white and mountain suckers, shorthead redhorse, longnose dace, fathead minnow, goldeye, yellow perch and mottled sculpin. Table 3-88 presents fish survey information collected since 1975.

Table 3-88. Combined results of game fish sampled from three electrofishing surveys on Warm Spring Creek downstream from the spring, 1975, 1981-82. Section lengths ranged from 1 to 2.5 miles.

Species	Number Captured	Average Length (in.)	Range	Average Weight (lb.)	Range
Rainbow trout	216	8.3	(3.9-17.2)	0.27	(0.03-2.36)
Brown trout	6	16.8	(14.5-19.7)	1.80	(1.21-2.95)
Smallmouth bass	7	9.2	(6.5-12.9)	0.54	(0.15-1.21)

A good trout fishery exists in the study reach. The statewide fishing pressure and harvest survey for 1982-86 reported an average of 1,200 angler-days of use per year (McFarland 1989).

There is a potential for improving the smallmouth bass population.

The riparian and aquatic habitats are in very good condition in the upper portion of the reach. However, fish habitat deteriorates substantially in the lower 5 miles of the stream. Poor agricultural practices, including overgrazing by livestock, have caused excessive bank erosion and increased siltation of the stream channel.

#### **WILDLIFE:**

Big game species found within the study reach include mule and white-tailed deer. Game birds present are ring-necked pheasant and Hungarian partridge. Mallard ducks use the stream throughout the ice-free period and tend to concentrate here during the late fall because of the warmwater conditions and the abundant supply of aquatic invertebrates. Beaver, mink, muskrat and raccoon are common furbearers.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in two riffle areas located approximately 200 yards downstream from the mouth of the Lincoln Ditch (Sec. 23, T17N, R17E). Five riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 100.1 and 148.9 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-81. An upper inflection point occurs at an approximate flow of 110 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to protect a spring creek aquatic system which is rather uncommon throughout Montana; to maintain the trout and bass populations; to provide flows for the Judith River; and assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.



#### **FLOW REQUEST:**

January 1 - December 31 -- 110 cfs (79,636 A.F./yr.)

The wetted perimeter-flow relationship developed for Warm Spring Creek is based on only two flows with a high flow less than 1.5 times the low flow. Therefore, the WETP analysis may be subject to substantial "two-point" error (Leathe & Nelson 1986).

Because Warm Spring Creek receives nearly all of its flow from a spring source, flows remain fairly constant. It is, therefore, difficult to model the stream using the wetted perimeter method. The WETP analysis was conducted as part of an evaluation for a proposed small hydro project. To get two flow measurements, transects were established downstream from a major irrigation diversion. High flow measurements were made with the headgate closed, then the headgate was opened to provide a low flow condition.

The requested flow of 110 cfs is less than the average base flow of 151 cfs measured just downstream from the spring during the 1968-71 water years, but is high enough to maintain this important spring creek fishery.

# WARM SPRING CREEK

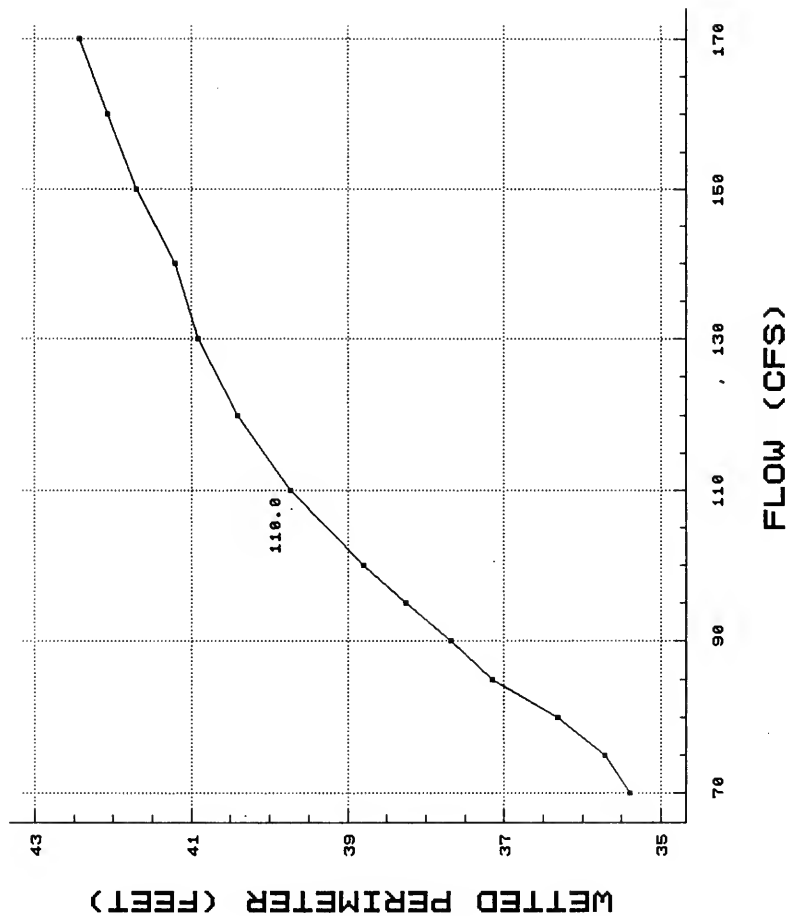


Figure 3-81. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Warm Spring Creek.

**STREAM NAME:** Cow Creek

**STREAM REACH:** From the confluence of the North and South forks of Cow Creek to the county bridge near T. U. Reservoir  
-- 2 miles

**LOCATION:** Sec. 18C, T27N, R19E to Sec. 20B, T27N, R19E

**DESCRIPTION OF STREAM REACH:**

Cow Creek is located in Blaine County. The stream originates in the Bear Paw Mountains (elevation 4,800 feet) and flows southeast for 54 miles through prairie foothills and steep Missouri River Breaks. Its confluence with the Missouri River (elevation 2,280 feet) is located 21 miles upstream from the U.S. Highway 191 bridge. The North Fork and South Fork of Cow Creek are the primary tributaries to Cow Creek.

The upper basin, where the study reach is situated, originates in the steep irregular drainages characteristic of their volcanic origin. The 2-mile reach flows through a moderately wide floodplain flanked by prairie parklands and steeply rolling foothills. The riparian zone is comprised of a narrow willow brushland interspersed with a few ponderosa pine and surrounded by meadow grasslands. A series of beaver dams near the lower end of the reach impounds the creek. The stream gradient is about 28 feet/mile with a silt laden, gravelly substrate.

Common land use above and adjacent to the study reach consists of livestock grazing and hay production. Hunting and fishing are popular recreational uses in this area. Although all of the upper basin is private land, public access is usually granted with permission.

**GAME FISH PRESENT:** Brook trout

**FISHERY:**

Brook trout are the only game fish present in Cow Creek and their distribution is confined to the headwaters. Non-game fish in this reach are white suckers and longnose dace. A 450-foot section located below the forks was sampled in October, 1987 using the two-pass method (Leathe 1983). A standing crop estimate is given in Table 3-89. Total trout numbers were estimated to be 4,187 fish/mile. This is an

especially abundant fish population and this high estimate may be due, in part, to fall spawning migrations from the series of beaver ponds downstream.

Table 3-89. Size statistics and standing crop estimates of brook trout sampled in the Moore Section of Cow Creek, October, 1987.\* (95% confidence interval in parentheses.)

Species	No.	Average Length (in.)	Range	Average Weight (lb.)	Range	No./ 1,000 ft.
Brook trout	346	7.7	(2.6-11.9)	0.18	(0.03-0.56)	793 ( $\pm$ 20)

\* Fish less than 4 inches were excluded from estimate and average size analysis.

This reach provides year-round habitat for brook trout as well as the primary spawning areas for fish inhabiting the downstream beaver ponds. Besides furnishing habitat, beaver ponds provide additional security during both high and low flow events. Cow Creek receives light fishing pressure.

#### WILDLIFE:

Big game inhabiting the reach are elk, mule and white-tailed deer. Game birds include ring-necked pheasant, Hungarian partridge and sharp-tailed grouse. Waterfowl use the many beaver ponds. Furbearers include beaver, mink and muskrat.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 550-foot section located 1 mile upstream from the bridge near T. U. Reservoir, (Sec. 18C, T27N, R19E). Five cross sections were established in three riffles. The WETP program was calibrated to field data collected at flows of 1.8 and 4.7 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-82. Lower and upper inflection points occur at approximate flows of 3.0 and 4.5 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident brook trout population; to provide spawning areas for those fish occupying the beaver ponds; and to assist in the maintenance of habitat for those wildlife species which rely upon the stream and its riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 4.5 cfs (3,258 A.F./yr.)

# COW CREEK

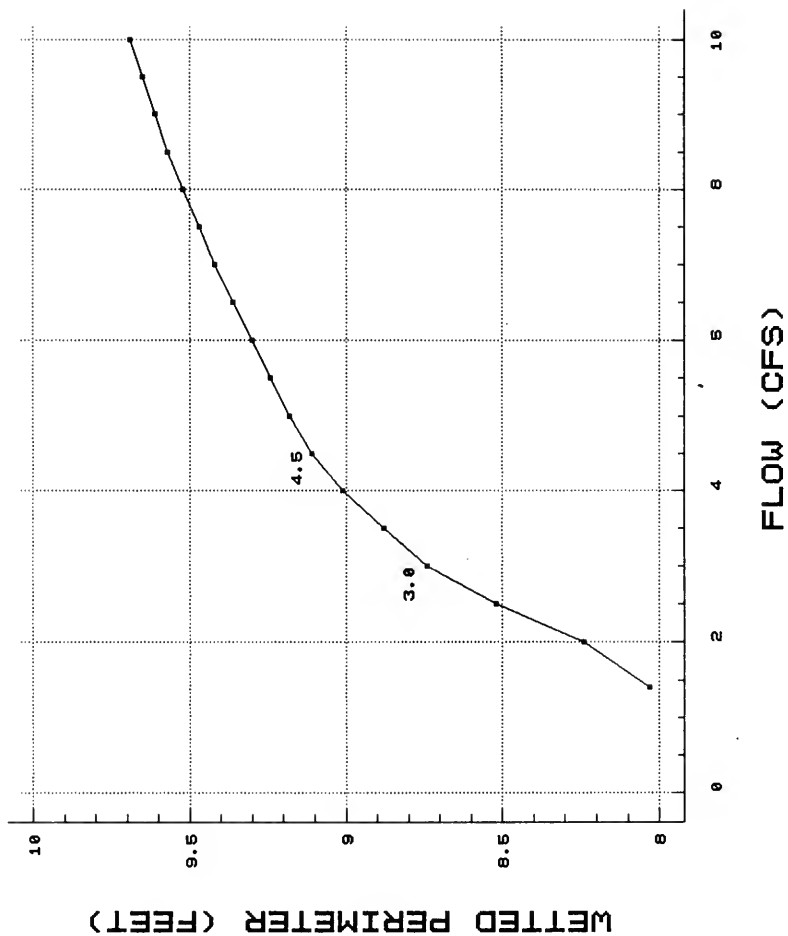


Figure 3-82.

The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Cow Creek.

## Musselshell River Drainage

Figure 3-83 is a map which shows the location of the following streams discussed in this section:

Musselshell River  
So. Fork Musselshell River  
Alabaugh Creek  
Cottonwood Creek  
No. Fork Musselshell River  
Checkerboard Creek

Spring Creek  
Big Elk Creek  
American Fork Creek  
Careless Creek  
Swimming Woman Creek  
Flatwillow Creek

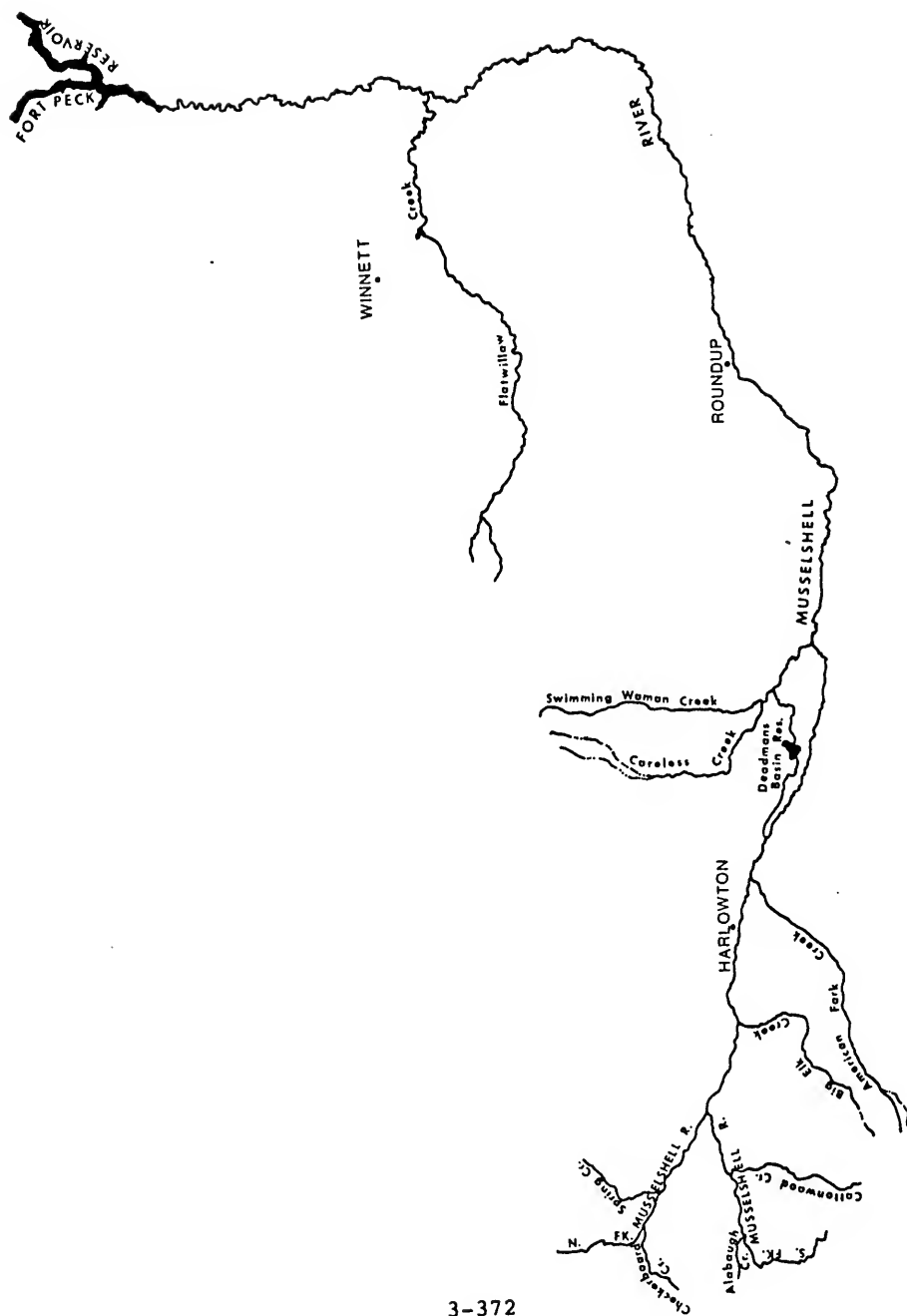


Figure 3-83. Location map for the Musselshell River Drainage.



**STREAM NAME:** Musselshell River

**DESCRIPTION OF THE BASIN:**

The Musselshell River drainage is situated in central Montana where surrounding topography is characterized by mountains in the west, rolling plains in central portions and badlands in the northeast.

Headwater tributaries arise in the Little Belt, Castle and Crazy mountains, forming the North and South forks of the Musselshell. Both forks flow easterly, converge near the town of Martinsdale, and continue in an easterly direction to the town of Melstone before turning northward to enter Fort Peck Reservoir on the Missouri River. From its origin at an elevation of 9,200 feet to the mouth at 2,200 feet, the Musselshell flows for 395 river miles. The basin has an approximate drainage area of 7,800 square miles and, as of 1987, an annual discharge near Mosby of 209,400 acre-feet (289 cfs).

The Musselshell basin is best described as a semi-arid region with a short growing season. Average annual precipitation ranges from 11.64 to 13.41 inches per year. Forty to fifty percent of the rainfall occurs in the spring months, with June being the wettest month.

Harlowton and Roundup are the two largest communities in the basin, having populations of 1,600 and 2,500, respectively.

Land use in the drainage is predominantly livestock grazing and modest farming activities. Some coal mining occurs in the southeastern region of the basin and moderate oil production occurs in the north. Recreation ranks third in economic importance in the basin.

Irrigation is the largest water consumer within the basin, utilizing approximately 477,194 acre-feet annually to irrigate 88,831 acres of land (Kaiser and Botz 1976). Three major storage reservoirs have been constructed in the upper drainage. Bair Reservoir on the North Fork, Martinsdale Reservoir on the South Fork and Deadmans Basin, fed by a diversion from the main river, have a combined storage capacity of 82,214 acre-feet. None of these reservoirs is large enough to provide complete regulation of flows in the Musselshell River, but between the three of them, they pretty well control summer flows in the river. Extensive irrigation throughout the basin results in serious dewatering problems in the Musselshell River and many tributary streams during most years.

Problems with water quality in the river system are attributed to agricultural runoff and irrigation return flows which cause increases in salinity, nutrient levels and sediment. These in turn contribute to high water temperatures and turbidities and lowered dissolved oxygen levels.

These water quality problems, along with the serious stream dewatering that occurs, can have serious impacts on the fishery throughout the basin.

The Musselshell Basin supports a wide variety of fish and wildlife which provide an important recreational resource for the region. The fishery in the Musselshell River can be separated into three biotic reaches or zones: (1) An upper coldwater zone, (2) a middle transitional zone and, (3) a lower warmwater zone. The stream reach write-ups and flow requests were developed around these three zones.

**STREAM NAME:** Musselshell River

**STREAM REACH:** #1. From the confluence of the North and South forks to Deadmans Basin Diversion -- 55.3 miles

**LOCATION:** Sec. 6C, T8N, R12E to Sec. 8B, T7N, R17E

**DESCRIPTION OF STREAM REACH:**

The upper Musselshell River flows eastward from the confluence of the North and South forks near Martinsdale to the Deadmans Basin Diversion Dam midway between Harlowton and Shawmut. It is a high quality trout stream meandering through dense riparian bottomland intermingled with hay meadows. The channel is generally 50-100 feet wide at a gradient of about 13 feet/mile over gravel and sand substrate and intermittent sandstone outcrops.

The drainage area above Harlowton is 1,125 square miles. Major tributaries include Little Elk, Miller, Big Elk, Lebo, and American Fork creeks arising from the Crazy Mountains to the south, and Daisy Dean, Haymaker, Hopley, and Antelope creeks arising from the Little Belt Mountains to the north. Bair Reservoir on the North Fork and Martinsdale Reservoir on the South Fork markedly influence streamflows. Diversions upstream from Harlowton (including the forks) irrigate about 37,000 acres (58 square miles) of land. They include at least 10 ditch systems with capacities of 15-400 cfs each as well as numerous pump operations.

At the lower end of this reach is the Deadmans Basin Diversion Dam. The Deadmans Basin Canal has a capacity of 600 cfs which is diverted into offstream storage at Deadmans Basin Reservoir. The reservoir, built in 1941, has a capacity of 76,900 acre-feet and covers 2,120 acres when full. Water diverted into Deadmans Basin during the non-irrigation season is returned via the Barber and Careless Creek canals during the irrigation season.

A USGS stream gauge is maintained at the town of Harlowton. It provides a 77-year period of record (1907 to 1987). Average annual flow during that period was 163 cfs with the lowest monthly base flows averaging 59 to 82 cfs during August through February. Other USGS gauge stations are located upstream on the North and South forks and downstream near Roundup.

The riparian area is mostly covered with dense cottonwoods and willows which provide high quality wildlife habitat. Numerous oxbow sloughs and wetlands exist as the result of meander cutoffs. These are both natural and man-caused in association with railroad and highway construction as well as agricultural activities. The land ownership is nearly all private. The river closely parallels U.S. Highway 12 along its length and there are numerous county road crossings. Stream access is generally good.

The intensive agricultural development of the Musselshell valley coupled with highway and railroad encroachment has severely degraded the stability of the Musselshell River channel. Water quality at Harlowton is moderately saline and nutrient-enriched as a result of irrigation return flows. Downstream from the Deadmans diversion, the water quality becomes largely unsuitable for trout due to increased sediment, temperature, and salinity.

**GAME FISH PRESENT:** Brown trout, mountain whitefish, rainbow trout

**FISHERY:**

The mainstem Musselshell River in this reach provides an outstanding brown trout fishery when sufficient instream flows are present to maintain population levels. The North and South forks are dominated by brook trout in the upper ends and brown trout downstream. Rainbow trout have become rare in the drainage since stocking was ceased about 1980, but some rainbow enter the system from Bair and Martinsdale reservoirs. Historically, the Musselshell has provided large fish, with brown trout over 5 pounds not uncommon. The abundant riparian growth provides excellent shade and cover, and, given adequate water conditions, an excellent fishery is maintained.

Population estimates using a mark-recapture method have been conducted annually since 1985 at the Selkirk fishing access site near the upstream end of this reach. Brown trout populations have shown a drastic decline since 1985 (Table 3-90). Drought conditions are believed responsible for this decline in the populations.

A mountain whitefish population estimate made in 1986 showed approximately 20 fish per 1,000 feet which ranged in length from 10.5-17.9 inches.

Table 3-90. Estimated standing crops of brown trout in a 1.25-mile section of the Musselshell River near Martinsdale during April, 1985-1988. (80% confidence intervals in parentheses.)

Species	Year	Length Group (in.)	Per 1,000 ft.	
			Numbers	Pounds
Brown trout	1985	6.0 - 12.9	46	19
		13.0 - 17.4	40	42
		17.5 - 20.4	<u>3</u>	<u>5</u>
			89 ( $\pm 10$ )	66 ( $\pm 6$ )
	1986	7.5 - 14.4	25	18
		14.5 - 20.4	<u>14</u>	<u>18</u>
			39 ( $\pm 5$ )	36 ( $\pm 5$ )
	1987	9.0 - 14.9	24	22
		15.0 - 25.4	<u>14</u>	<u>20</u>
			38 ( $\pm 16$ )	42 ( $\pm 4$ )
	1988	7.5 - 13.9	11	6
		14.0 - 20.4	<u>10</u>	<u>16</u>
			21 ( $\pm 3$ )	22 ( $\pm 2$ )

The Musselshell River fishery has been severely depleted in recent years due to low streamflows, excessive irrigation withdrawals, and associated problems of siltation and high water temperatures.

The river below Deadmans Basin Diversion has been dry for months at a time during recent years and consequently fails to sustain a trout fishery. For that reason, the diversion is chosen as the lower point of this stream reach.

This stream reach averaged over 5,200 angler-days of use in the 1982-86 period (McFarland 1989).

#### WILDLIFE:

The upper Musselshell River provides one of the richest and most diverse riparian wildlife ecosystems in the entire state. Dense populations of white-tailed deer inhabit the corridor and mule deer and antelope are abundant along the irrigated hayfields and pastures associated with the river. Beaver, mink, muskrat, and bobcat are common. Pheasants, doves, sharp-tailed grouse, sandhill cranes, mallards and other

waterfowl, and a broad diversity of songbirds are abundant--both nesting and migrating populations. The corridor also hosts a diverse raptor population including numerous migrating and overwintering bald eagles.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in an 800-foot section of the Musselshell River located about 2 miles upstream from Harlowton (Sec. 20C, T8N, R15E). Five riffle cross sections were established, with four used in the analysis. One cross section was not used due to calibration problems. The WETP program was calibrated to field data collected when flows recorded at the Harlowton gauging station were 42.8, 60.0 and 184.0 cfs.

The relationship between wetted perimeter and flow from a composite of the four riffle cross sections is shown in Figure 3-84. Lower and upper inflection points occur at approximately 26 and 140 cfs, respectively. The requested flow of 80 cfs is intermediate between the two flows and is about half the mean annual flow.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to sustain a high quality wild brown trout fishery in the Musselshell River. The population data have demonstrated a severe population decline during recent drought conditions approximating lower inflection point flows. Streamflow is the limiting factor to the Musselshell River fishery. This flow will also help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 80 cfs (57,917 A.F./yr.)

Man-caused depletions of streamflow in this reach have altered the natural flow regime. As a result, the upper inflection point flow of 140 cfs is probably not available in most years.

Observation of the stream at 42.8 cfs showed that much of the riffle area was exposed and fish habitat along the banks was typically dewatered. Consequently, flows in this range and lower were judged inadequate to sustain the fishery at a high level of aquatic habitat potential. The fishery data presented above shows a 75% decline in numbers and 67% decline

in biomass associated with a prolonged drought period (1985-88) during which streamflows at Harlowton reached base levels of 22, 46, and 26 cfs (the lowest monthly mean flow at Harlowton during 1985, 1986, and 1987, respectively). In the three years prior to that (1982, 1983 and 1984) the lowest monthly means were 42, 43 and 49 cfs, respectively and average flows for 28 of the 36 months exceeded 80 cfs. During 1985, 1986 and 1987, monthly mean flows were less than 80 cfs for 25 of the 36 months but the average monthly discharge for the period was about 80 cfs.

# MUSSELSHELL RIVER (reach 1)

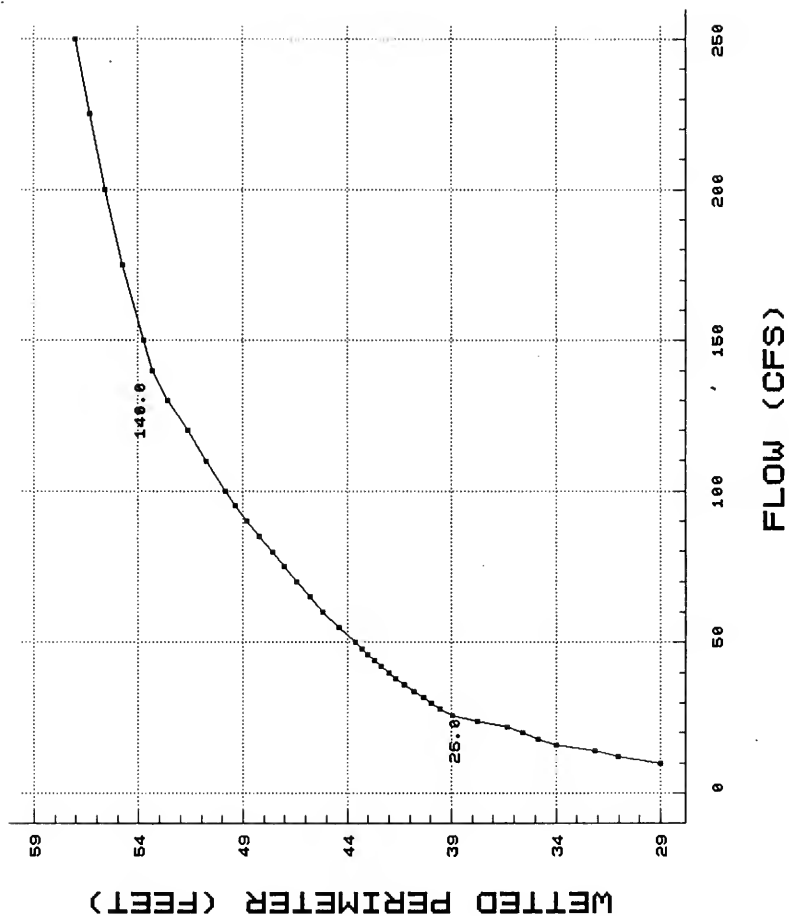


Figure 3-84. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Reach 1 of the Musselshell River.



**STREAM NAME:** Musselshell River

**STREAM REACH:** #2. From Deadmans Basin Diversion to Musselshell Diversion -- 145.9 miles

**LOCATION:** Sec. 8B, T7N, R17E to Sec. 28B, T9N, R29E

**DESCRIPTION OF STREAM REACH:**

The middle reach of the Musselshell River flows eastward from Deadmans Basin Diversion midway between Harlowton and Shawmut to the Musselshell Diversion at the town of Musselshell. This reach of the river receives tributary inflow from several streams draining the Big Snowy and Little Snowy mountains to the North, including Careless, Currant, Pole and Willow creeks. Additional inflow from Deadmans Basin Reservoir enters the reach through releases into Careless Creek and the Barber Canal. Tributaries from the south include Fish, Big Coulee, Painted Robe and Dean creeks, which drain agricultural land, and Goulding, Halfbreed, Parrot, Fattig and Hawk creeks which drain the Bull Mountains. All of the tributaries to this reach of the Musselshell are subject to dewatering and are normally dry or intermittent during the irrigation season.

The middle reach of the Musselshell River meanders broadly through an extensive cottonwood-willow riparian zone. Gradient averages about 7 feet per mile with a channel width of about 75-125 feet. Substrate is mostly sand, silt, and gravel with broken rocky outcrops along sandstone cliffs. Elevation ranges from 3,000 to 4,000 feet. Water clarity is generally high at the upstream end of the reach except during runoff events and the irrigation season. Turbidity increases downstream and is generally moderate to high at the lower end of the reach.

USGS stream gauges are present at Harlowton (see Reach #1), Ryegate (1946 to 1979), Roundup (1946 to present), and Musselshell (1928 to the present). Mean annual discharge at Ryegate, Roundup and Musselshell was 188 cfs, 224 cfs, and 215 cfs, respectively.

Diversions for agriculture are extensive throughout the reach. Between Harlowton and Musselshell, diversions for irrigation total about 26,000 acres (40.6 square miles) and include at least eight diversions with capacities of 25 to 90 cfs each. In addition, there are well over a dozen pumpsites. The lower

end of this reach is the Musselshell Diversion dam which has an additional capacity of 235 cfs and is the next-to-last diversion on the river.

The entire reach flows through private agricultural land that is intensively farmed and grazed. Numerous oxbow sloughs and wetlands are found along the riparian zone as a result of meander cutoffs, both man-caused and natural. Railroad and highway construction encroached severely on the river at the turn of the century. A 1980 streambank physical features inventory conducted by the Montana Department of Health and Environmental Sciences in the river between Shawmut and Melstone identified over 51,000 feet of channel alterations amounting to 6% of the channel length. Construction of the Milwaukee Railroad, completed in 1908, included 117 channel changes or bridges between Harlowton and Melstone. The inventory identified over 31% of the riverbank from Shawmut to Melstone as unstable and eroding. Nearly 35,000 feet of rock riprap has been installed (Montana Department of Health and Environmental Sciences 1980).

Water quality is rapidly degraded downstream from Deadmans Basin Diversion. The water is high in sodium-sulfate and is nutrient-enriched. Careless Creek dumped in 30 tons of sediment per day according to a 1976 study (Kaiser and Botz 1976). This is primarily due to an unstable channel caused by excessive scouring from Deadmans Basin water spills. Salinity in much of this river reach is high enough to cause damage to some crops. Water temperatures at Roundup frequently reach 82 F in July and August. An occasional brown trout is found in the upper portion of this stream reach, but, for the most part, water quality in the reach is unsuitable for trout.

**GAME FISH PRESENT:** Smallmouth bass, channel catfish, brown trout

**FISHERY:**

This reach of the Musselshell River provides a poor fishery. It represents a transition zone from the upstream trout fishery to the warmwater fishery downstream. Diversion dams block migration throughout this reach. Warmwater game fish migrate upstream from the lower river and Fort Peck Reservoir but are unable to ascend the Musselshell diversion which forms the lower boundary of this reach. Smallmouth bass were introduced into this reach in 1977-81 in an attempt to provide

a fishery. Reproducing populations were established but chronically poor streamflow conditions have precluded development of a viable fishery in recent years.

Game fish populations in this river reach are too low to obtain accurate estimates. Extensive electrofishing, trap-netting and seining surveys during 1978-86 have adequately identified the species composition. An abundant and diverse minnow forage base exists. Collections of northern redbelly dace X finescale dace hybrids were made in 1985 in this reach. They are classified as a "Species of Special Concern" in Montana.

Fishing pressure in this stream reach is minimal. Children from local communities such as Roundup provide most of the angling pressure. The fishery is not expected to improve unless flows can be dramatically increased. Long sections of this reach of the Musselshell go dry almost annually.

#### **WILDLIFE:**

The Musselshell River provides one of the richest and most diverse riparian wildlife ecosystems in Montana. Dense populations of white-tailed deer inhabit the corridor and mule deer and antelope are abundant along the irrigated hayfields and pastures associated with the river. Beaver, mink, muskrat and bobcat are common. Wild turkeys, pheasants, doves, sharp-tailed grouse, mallards and other waterfowl and a broad diversity of songbirds are abundant--both nesting and migratory populations. The corridor also hosts a diverse raptor population, including migrating and overwintering bald eagles.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 150-foot section of the Musselshell River at the downstream end of the city of Roundup (Sec. 24A, T8N, R25E). Five riffle cross sections were established. The WETP program was calibrated to field data collected when flows at the Roundup USGS gauging site were 20.0, 76.7 and 208.0 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in Figure 3-85. Lower and upper inflection points occur at approximately 32 and 130 cfs, respectively. The requested flow of 80 cfs is intermediate between these points.

#### WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the present warmwater fishery in this reach of the Musselshell River. This flow will also help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### FLOW REQUEST:

January 1-December 31 -- 80 cfs (57,917 A.F./yr.)

Man-caused depletions of streamflow have altered the natural flow regime. The requested flow reflects a poorer quality fishery in this reach of the river, due in large part to dewatering of the stream. Observation of the river at 76.7 cfs on 9/2/87 indicates that flows in this range leave some gravel bars exposed but provide a moderate level of fish habitat. The minimum mean monthly flow historically occurs in January at Roundup and averages 67 cfs for the period of record. At the present time, flows in this reach of the river frequently drop to zero.

# MUSSELSHELL RIVER (reach 2)

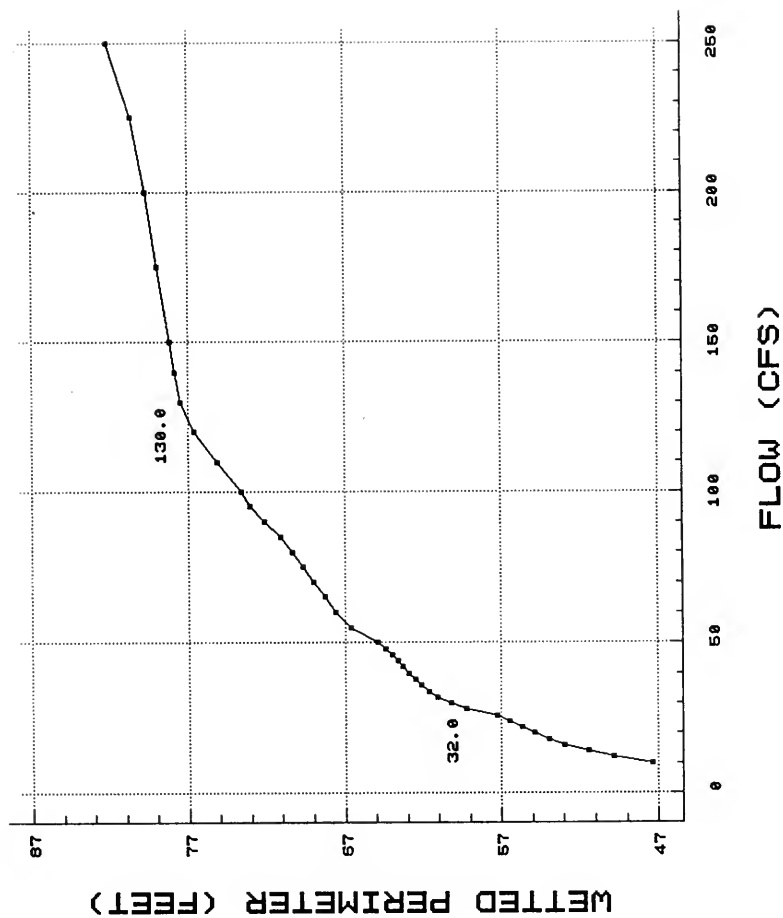


Figure 3-85. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 2 of the Musselshell River.

**STREAM NAME:** Musselshell River

**STREAM REACH:** #3. From Musselshell Diversion Dam at the town of Musselshell to the mouth -- 163.0 miles

**LOCATION:** Sec. 28B, T9N, R29E to Sec. 36D, T19N, R29E

**DESCRIPTION OF STREAM REACH:**

This reach represents the free-flowing warmwater portion of the Musselshell River. From the town of Musselshell the river flows east for twenty-five miles and then turns north to its confluence with Fort Peck Reservoir. Major tributaries are North Willow and Flatwillow creeks from the west and Rattlesnake, Calf, and Lodgepole creeks from the east. The river flows through a deeply-incised channel alternating between sandstone and clay bluffs and riparian flats densely covered with cottonwood and willow growth. Most of the surrounding semiarid uplands are rolling sagebrush grasslands. The substrate is mostly sand and silt with gravel interspersed in riffle areas. The river meanders broadly across the fairly narrow floodplain. The water is moderately to highly turbid, especially when flow levels are high.

Channel width is 100-150 feet in most of this reach with an average gradient of 4.5 feet per mile. A USGS stream gauge is operated at Mosby which has a period of record from 1931 to the present. It is located 60 miles upstream from the mouth, about 2/3 of the way down this reach of river and below most of the irrigation withdrawals. The drainage area at Mosby is 7,846 square miles. Average annual flow at Mosby is 289 cfs, with the lowest monthly base flows averaging 70-77 cfs during October through January.

Diversions for irrigation of about 40,000 acres occur in this reach but nearly all of that comes from the Musselshell Diversion which forms the upper reach boundary. Only one other major diversion, Korenko Dam, is located in this reach and it is only 2.5 miles downstream from Musselshell Diversion. Numerous pump sites occur in the river valley further downstream.

Land ownership of the river bottom is mostly private but about half of the surrounding uplands are public grazing land administered by the BLM. A number of oil fields are found in the vicinity. Access to the stream is generally good in the upper portion which is paralleled by U.S. 12 and county roads. Access from Mosby downstream is more limited.

Water quality in the reach is poor. Water is high in suspended sediment, salts, and fecal coliforms during much of the year. The tributaries generally drain largely agricultural areas and contribute poor quality water to the system.

**GAME FISH PRESENT:** Sauger, channel catfish, smallmouth bass, black bullhead, northern pike, walleye

#### **FISHERY:**

The lower reaches of the Musselshell River provide a good to excellent warmwater fishery on a seasonal basis. Spring runoff triggers an upstream migration of sauger and channel catfish from Fort Peck Reservoir. Thirty-one channel catfish tagged in the upper end of Fort Peck Reservoir were recaptured from 1978 through 1981 in the Musselshell River as far upstream as Musselshell Diversion and in Flatwillow and Box Elder Creeks. No quantitative information is available on the size of the channel catfish run but hoop-net surveys in 1981 captured over 200 fish. Larval fish surveys documented channel catfish reproduction in the river in 1981, indicating the lower Musselshell is an important spawning and rearing area for channel catfish from Fort Peck Reservoir. The same is probably true for sauger, but this has not been documented.

Smallmouth bass are found mostly in the upper end of this reach but have recently established themselves in Fort Peck Reservoir, possibly as a result of the Musselshell River introductions from 1977 through 1981. Smallmouth bass may also establish a migratory pattern in the lower Musselshell over time. Northern pike and walleye are incidental species in the river system. Occasional capture of these species is probably a result of upstream migration from Fort Peck Reservoir.

The river supports a diverse array of sucker and minnow species in addition to black bullheads and stonecats. As was previously mentioned, there are no barriers in this reach except for Musselshell Diversion, the upstream reach boundary, which totally blocks upstream migration of warmwater game fish. Fishing pressure surveys estimated almost 4,000 man-days of use per year between 1982-86 (McFarland 1989).

#### **WILDLIFE:**

The lower Musselshell River is an important riparian ecosystem in an otherwise semiarid region of the state. White-tailed deer, mule deer, and antelope frequent the area. Beaver, mink, muskrat, and bobcat are common. Wild turkey, pheasants, doves, sharp-tailed and sage grouse, some waterfowl, and a broad diversity of songbirds are dependent on the riparian bottomlands for nesting and rearing habitat. The corridor also hosts a diverse raptor population including migratory bald eagles.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 400-foot section of the Musselshell River located immediately upstream from the highway bridge at Mosby (Sec. 11B, T14N, R30E). Five riffle cross sections were established. The WETP program was calibrated to field data collected when flows at the Mosby USGS gauging station immediately upstream were 20.0, 118.0, and 225.0 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in Figure 3-86. Lower and upper inflection points occur at approximately 22 and 70 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the lower Musselshell River as a spawning and rearing tributary for channel catfish, sauger, and possibly smallmouth bass from Fort Peck Reservoir, and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter. Additionally, the requested flow will help prevent any further increase in high salt loads which are detrimental to riparian development and which adversely affect fish and wildlife. The requested flow approximates the existing condition in this reach of the Musselshell River.

#### **FLOW REQUEST:**

January 1-December 31 -- 70 cfs (50,678 A.F./yr.)



# MUSSELSHELL RIVER (reach 3)

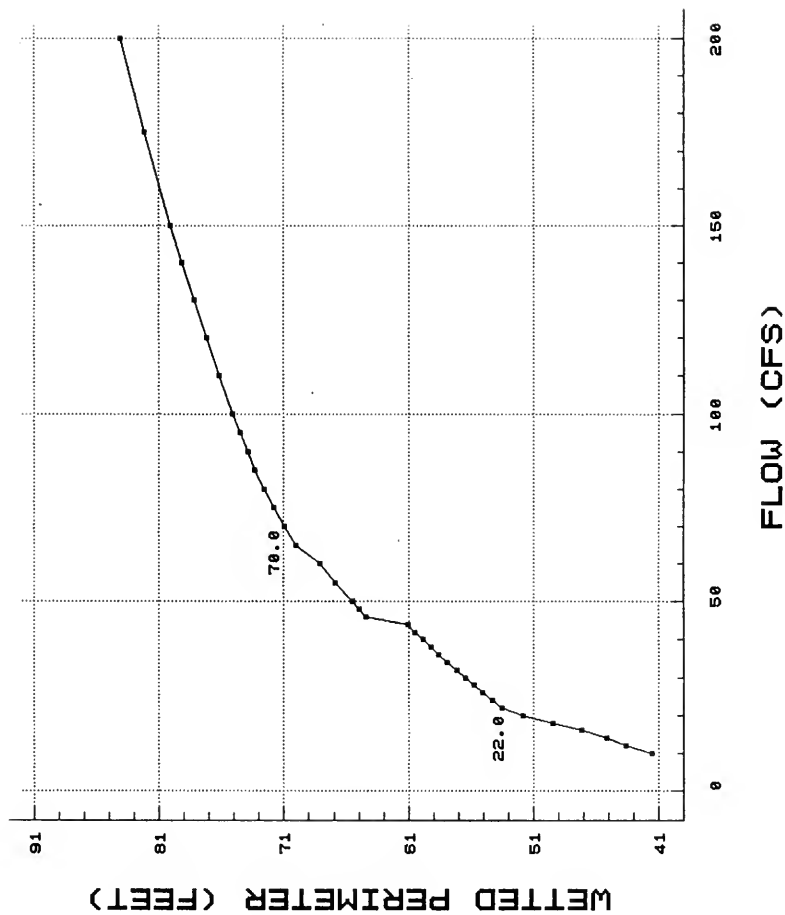


Figure 3-86. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 3 of the Musselshell River.

**STREAM NAME:** South Fork Musselshell River

**STREAM REACH:** From the headwaters to its confluence with the North Fork - 30 miles

**LOCATION:** Sec. 31A, T7N, R9E to Sec. 6C, T8N, R12E

**DESCRIPTION OF STREAM REACH:**

The South Fork Musselshell River originates in the steep Rimrock Reef area along the west edge of the Crazy Mountains. It flows north through the foothills of the Crazy's, then turns northeast at the foothills of the Castle Mountains. It continues to flow along the south edge of the Castles, opening into a wide valley below the town of Lennup. Average stream gradient for the entire reach is 44.5 feet/mile. Tributaries to the South Fork include Dry and Bozeman forks of the Musselshell, Slaughter House, Sawmill, Deer, Alabaugh, Comb, Muddy (two), Coyote, Cottonwood, and Willow creeks. These streams drain the Castle Mountains from the north, and the Crazy Mountains from the south.

USGS discharge records are available from October 1941 to September 1979 for a gauge located 6 miles upstream from the mouth (Sec. 17 B & C, T8N, R11E). Maximum flow recorded in June 1975 was 5,240 cfs, minimum flow recorded August and September 1949 and March 1950 was 0.1 cfs. Average daily discharge for 38 years of record was 91.3 cfs or 66,150 acre-feet/year.

Substrate throughout the entire reach is gravel and cobbles with considerable silt. The riparian area is in relatively good condition along most of the stream. Major vegetation on the upper and middle sections is willows, with cottonwood trees becoming predominant below the confluence of Cottonwood Creek. Surrounding country in the headwater and foothill sections is sage brush and grass with some pockets of conifers. In the valley below Lennup, most of the surrounding land has been developed into pasture and hay meadows. Land ownership is almost 100% private. Stream access varies with landowners, but is generally good.

A large quantity of irrigation return flows as well as intensive grazing and farming in the drainage have resulted in a serious sedimentation problem in the South Fork. The old Chicago, Milwaukee, St. Paul and Pacific railroad runs right along the stream bottom for about 15 miles and has had a major physical impact on the stream.

Water is diverted to irrigate approximately 6,600 acres in the South Fork valley. Diversion structures occur as far upstream as the Bozeman Fork, and are common throughout the lower valley. A large structure located approximately 3 miles upstream from the mouth diverts almost the entire flow of the South Fork to Martinsdale Reservoir.

**GAME FISH PRESENT:** Brown trout, rainbow trout, brook trout

**FISHERY:**

On October 15, 1987, a 650-foot section of the South Fork upstream from the USGS gauge (Sec. 17 B & C, T8N, R11E) was sampled by electrofishing. The stream in this section contained a good riffle-run-pool sequence. Several pools over 4 feet deep, undercut banks, overhanging vegetation and woody debris provided excellent fish habitat. Substrate was a thick layer of silt in the pools and runs with some gravel and cobbles in the riffles.

Brown trout were the only game fish captured. Sixty-seven brown trout ranging from 2.9 to 17.9 inches total length were captured. Ten of these fish were greater than 15 inches long. Other fish species seen included white suckers and mottled sculpin.

The two-pass method (Leathe 1983) was used to estimate the brown trout population in this 650-foot section. Results of this estimate are shown in Table 3-91.

Table 3-91. Estimated brown trout population in 650 feet of the South Fork Musselshell River sampled October 15, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 650 ft.
Brown trout	≥ 3	66 (± 1)
Brown trout	≥ 6	39 (± 1)

A second, 350-foot, section of the South Fork on the Knute Herheim Ranch above Lennup (Sec. 35, T8N, R9E) was electrofished in 1988. This section contained good riparian vegetation and had a thick sediment bottom. Rainbow, brown and brook trout were collected, with one brown trout weighing over 4 pounds. Table 3-92 summarizes the results of this sampling.

Table 3-92. Summary of electrofishing results for 350 feet of the South Fork Musselshell River sampled June 8, 1988.

Species	Number	Mean Length (in.)	Length Range (in.)
Rainbow trout	18	9.0	4.2 - 15.4
Brook trout	10	5.9	4.7 - 8.6
Brown trout	6	15.7	4.4 - 24.5

During years of very high flow, there may be some brown trout migrating up the South Fork in the fall. In the fall of 1986, several large brown trout were observed trying to jump the Martinsdale diversion structure which creates a total barrier during low flows. In 1987, the channel below this structure was almost totally dewatered all summer and fall so no migration could occur.

Other fisheries problems include a serious sedimentation problem resulting from intense grazing and hay farming along most of the drainage, and the large number of irrigation returns entering the river. Extensive irrigation in the drainage also affects stream temperatures during the hot part of the summer.

#### WILDLIFE:

Big game species utilizing the riparian area of the South Fork include mule and white-tailed deer, antelope, elk, black bear, mountain lion, and an occasional moose. Upland game birds include the blue and ruffed grouse in the headwaters, and Hungarian partridge and sage grouse in the lower drainage. Furbearers include beaver, muskrat, mink, weasel, bobcat and lynx. Other wildlife include badger and coyote. A large variety of raptors utilize this drainage for hunting and nesting.

A variety of waterfowl utilize the river and the many irrigation ditches in the drainage for nesting and as resting areas during spring and fall migrations.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 450-foot section of the South Fork located approximately 1/4 mile upstream from the Martinsdale diversion (Sec. 15B, T7N, R11E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 8.3, 46.6 and 59.3 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-87. Lower and upper inflection points occur at approximate flows of 12 and 30 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout fishery, to maintain some flow for the already seriously dewatered lower section of the South Fork, to help maintain suitable water temperatures for trout, and to help protect the habitat for wildlife species which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 30 cfs (21,719 A.F./yr.)

# SOUTH FORK MUSSELSHELL RIVER

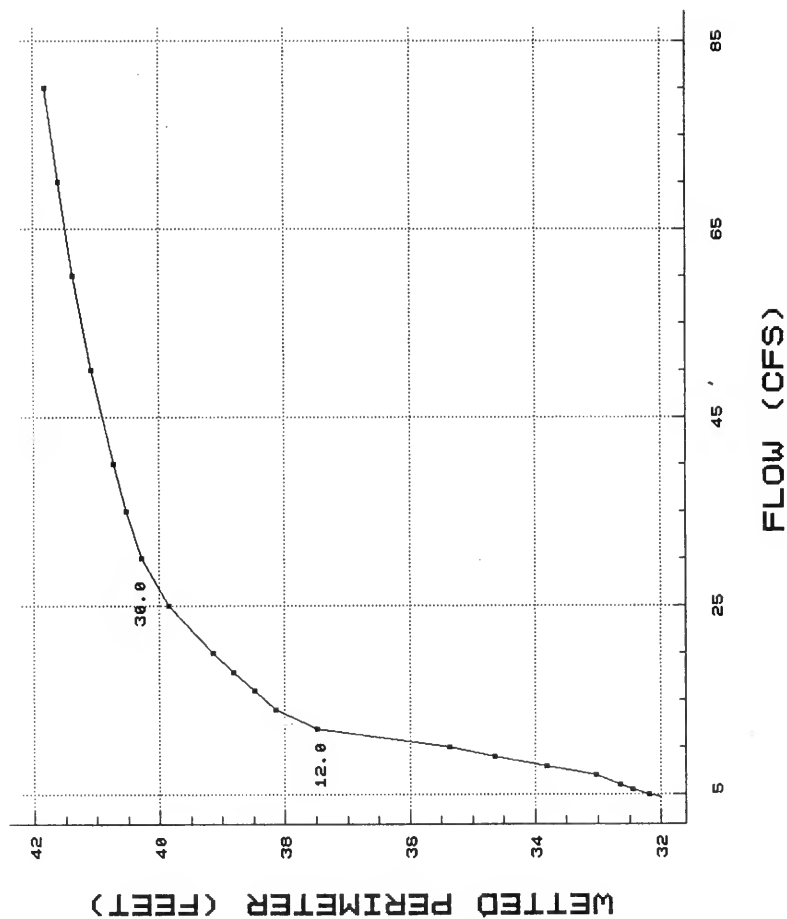


Figure 3-87. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in the South Fork of the Musselshell River.

**STREAM NAME:** Alabaugh Creek

**STREAM REACH:** From the headwaters to the mouth -- 9.0 miles

**LOCATION:** Sec. 21B, T8N, R8E to Sec. 36B, T8N, R9E

**DESCRIPTION OF STREAM REACH:**

Alabaugh Creek originates in the southwestern corner of the Castle Mountains and flows easterly for approximately 9 miles before entering the South Fork Musselshell River near Lennep. Major tributaries include Boulder, Castle, Kensley, Medow and Robinson creeks.

The headwaters of Alabaugh Creek are in steep, timbered mountains on the Lewis and Clark National Forest. Gradient in the upper 7 miles averages about 291 feet/mile. The stream is confined in a steep narrow valley near the upper end of the reach. The valley bottom begins to widen near the middle of the reach and the lower two miles of stream flows through a wide, low gradient valley. Substrate is cobbles and large boulders with an increase in gravel and silt in the lower valley. Riparian vegetation varies from mature conifers in the headwaters to an open willow-cottonwood bottom in the middle section to thick willows in the lower end.

Major land uses in the area include grazing, hay production and recreation. Historically this drainage has been an important mining area, especially in the Castle Creek drainage. There is currently no active mining occurring in the drainage.

Land ownership is 27% national forest and 73% private. Access to the upper areas is provided by Forest Service trails. Access to the private lands varies with the landowners.

A gravel road follows the stream for the lower 5 miles, crossing it at several locations, but it does not appear to impact the stream. Several private irrigation diversions withdraw water from Alabaugh Creek downstream from the national forest boundary.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout

## FISHERY:

A 300-foot section of Alabaugh Creek approximately 1/4 mile upstream from the first bridge above Lennep (Sec. 26C, T8N, R9E) was sampled by electrofishing on October 8, 1987.

This section contained well developed pools and runs with one good riffle area. Cover was provided by undercut banks and overhanging willows. Substrate consisted of fine gravel and silt. Riparian vegetation consisted of thick willows and natural grass. Cattle grazing was evidenced by some minor bank erosion. Stream width averaged about 10 feet and maximum pool depth was about 4 feet.

Alabaugh Creek supports an excellent trout population for a stream of its size. Brook trout made up approximately 68% of the trout catch with the remaining 32% about evenly divided between rainbow and brown trout. Mottled sculpins were also numerous. Electrofishing data are summarized in Table 3-93.

Table 3-93. Summary of electrofishing catch for 300 feet of Alabaugh Creek sampled October 8, 1987.

Species	Number Captured	Length Range (in.)
Brook trout	192	2.4 - 10.8
Rainbow trout	51	2.5 - 10.9
Brown trout	41	2.9 - 14.8

The two-pass method (Leathe 1983) was used to estimate the trout population in this 300-foot section (Table 3-94).

Table 3-94. Estimated trout population in 300 feet of Alabaugh Creek sampled October 8, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 300 ft.
Brook trout	2.4 - 10.8	196 ( $\pm 4$ )
Rainbow trout	2.5 - 10.9	58 ( $\pm 7$ )
Brown trout	2.9 - 14.8	47 ( $\pm 7$ )
Combined trout	2.4 - 14.8	297 ( $\pm 10$ )
Combined trout	$\geq 6$	99 ( $\pm 2$ )



#### **WILDLIFE:**

Big game species using the area include antelope, mule and white-tailed deer, elk, black bear and mountain lion. Game birds include blue and ruffed grouse in the upper reaches and Hungarian partridge near the lower end. Furbearers include bobcat, mink, muskrat and beaver. The lower end provides some good waterfowl habitat.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 240-foot section of Alabaugh Creek located approximately 1/4 mile upstream from the first bridge above Lennep (Sec. 26C, T8N, R9E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 2.8, 10.4 and 21.0 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-88. Lower and upper inflection points occur at approximate flows of 6 and 12 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing diverse resident trout population and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 12 cfs (8,688 A.F./yr.)

# ALABAUGH CREEK

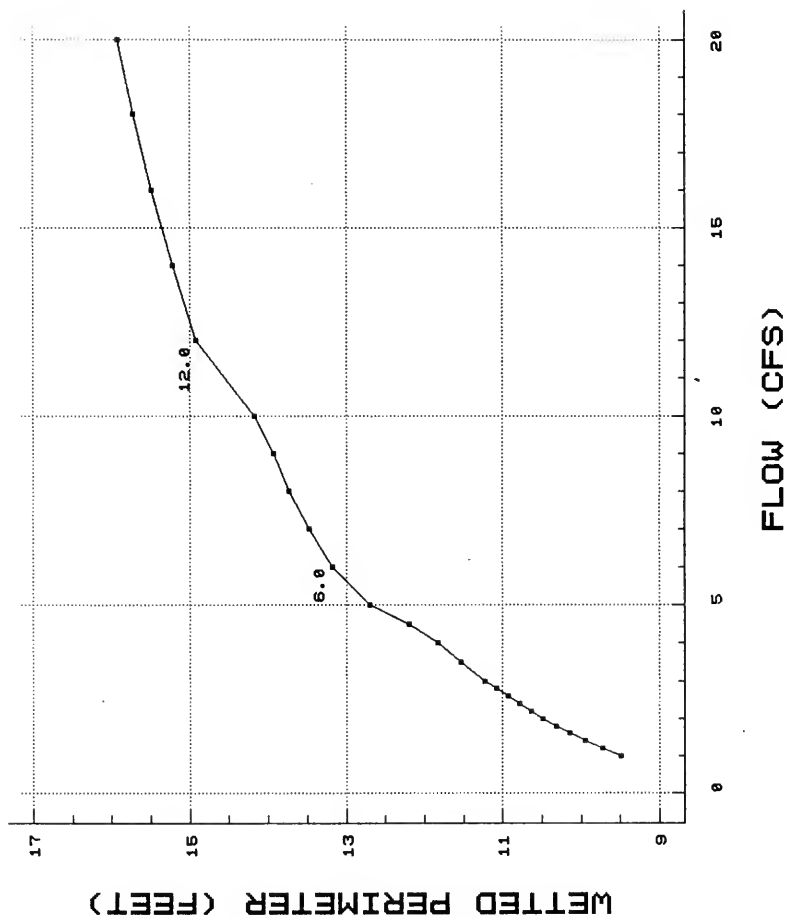


Figure 3-88. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Alabaugh Creek.

**STREAM NAME:** Cottonwood Creek

**STREAM REACH:** From the confluences of the West Fork, Middle Fork and Loco Creek to the mouth -- 10.8 miles

**LOCATION:** Sec. 1A, T6N, R10E to Sec. 19B, T8N, R11E

**DESCRIPTION OF STREAM REACH:**

Cottonwood Creek is formed from the confluence of the West Fork, Middle Fork and Loco Creek on the northern edge of the Crazy Mountains. It flows north to its confluence with the South Fork Musselshell River approximately 5 miles above the Martinsdale diversion. Lost Horse Creek is the only major tributary entering this reach. Several small springs also contribute water along this reach.

The upper 3 miles of Cottonwood Creek flow through a narrow entrenched valley bordered by numerous bedrock outcroppings. Below this the stream meanders through a wide valley bottom. Stream gradient is about 67 feet/mile and average stream width is about 20 feet. Substrate consists of boulders and cobbles with fine gravel in slower moving areas. Water clarity is very good. Large woody debris is common in the stream channel, resulting in the development of good pools. The riparian zone is well developed and vegetation consists of mature cottonwoods, juniper, willows, water birch, rose and snowberry bushes. Conifers are more common in the riparian zone near the upper end of the reach. Smaller riparian vegetation has been partially denuded by cattle grazing. Several large hay meadows are also present along the stream bottom.

Major land uses outside the riparian zone include cattle grazing and hay production.

Land ownership is 100% private. Hunting access rights are leased along most of the stream, but fisherman are generally allowed access with permission.

Three diversions withdraw water from Loco Creek and the Middle Fork above their confluence, and two large ditches withdraw water from the reach below their confluence. A diversion located 3 miles upstream from the mouth completely dewateres the lower section of Cottonwood Creek during the irrigation season.

**GAME FISH PRESENT:** Brown trout, rainbow trout, brook trout, cutthroat trout

**FISHERY:**

A two-pass method (Leathe 1983) estimate was made on a 500-foot section of Cottonwood Creek (Sec. 18C, T8N, R11E) in early October, 1987. This section contained several well-developed pools formed around large fallen cottonwoods. Maximum pool depth was approximately 5 feet. Pools were connected by fast, shallow runs. Substrate was cobbles and boulders.

Considering its size and severe dewatering problem at the lower end, Cottonwood Creek supports a large, diverse resident trout population. A summary of electrofishing results is presented in Table 3-95. Brown trout were the dominant species collected, comprising 53% of the total catch; rainbow accounted for 44% of the catch. A few small brook trout and one 12.6 inch cutthroat trout were also collected.

Table 3-95. Summary of electrofishing catch for 500 feet of Cottonwood Creek sampled October 8, 1987.

Species	Number Captured	Length Range (in.)
Brown trout	121	2.4 - 19.9
Rainbow trout	100	2.1 - 16.8
Brook trout	7	2.7 - 8.9
Cutthroat trout	1	12.6

Large numbers of small (2-4 inch) brown and rainbow trout were collected from the boulder-cobble substrate in the riffle-run areas, indicating the stream provides important rearing habitat for both species.

The estimated trout populations for this 500-foot section of stream are presented in Table 3-96. Large numbers of mottled sculpin were also observed in this section.

Table 3-96. Estimated trout population in 500 feet of Cottonwood Creek sampled October 8, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 500 ft.
Brown trout	2.4 - 19.9	122 ( $\pm$ 2)
Rainbow trout	2.1 - 16.8	104 ( $\pm$ 4)
Brook trout	2.7 - 8.9	7 ( $\pm$ 1)
Combined trout	2.1 - 19.9	234 ( $\pm$ 4)
Combined trout	$\geq$ 6	61 ( $\pm$ 1)

Although Cottonwood Creek contains an excellent population of catchable sized trout, fishing pressure is probably light due to limited access.

#### WILDLIFE:

The riparian zone along Cottonwood Creek supports an excellent population of mule and white-tailed deer, elk and antelope. Moose and black bear from the Crazy Mountains also use this lower area at times. Blue and ruffed grouse utilize the streamside habitat near the upper end of the reach while Hungarian partridge and sage grouse are found in the valley. Other wildlife include beaver, muskrat, mink, badger, bobcat, coyote and various raptors. There is a limited amount of duck nesting along the lower end of the stream.

#### WETTED PERIMETER:

Cross-sectional data were collected in an approximate 350-foot section of Cottonwood Creek just upstream from a ranch road ford (Sec. 18D, T7N, R11E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 9.1, 31.7, 48.8, 54.4 and 106 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-89. An upper inflection point occurs at an approximate flow of 16 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing diverse resident trout population, the important rearing habitat provided by the shallow riffle-run areas and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 16 cfs (11,583 A.F./yr.)

# COTTONWOOD CREEK

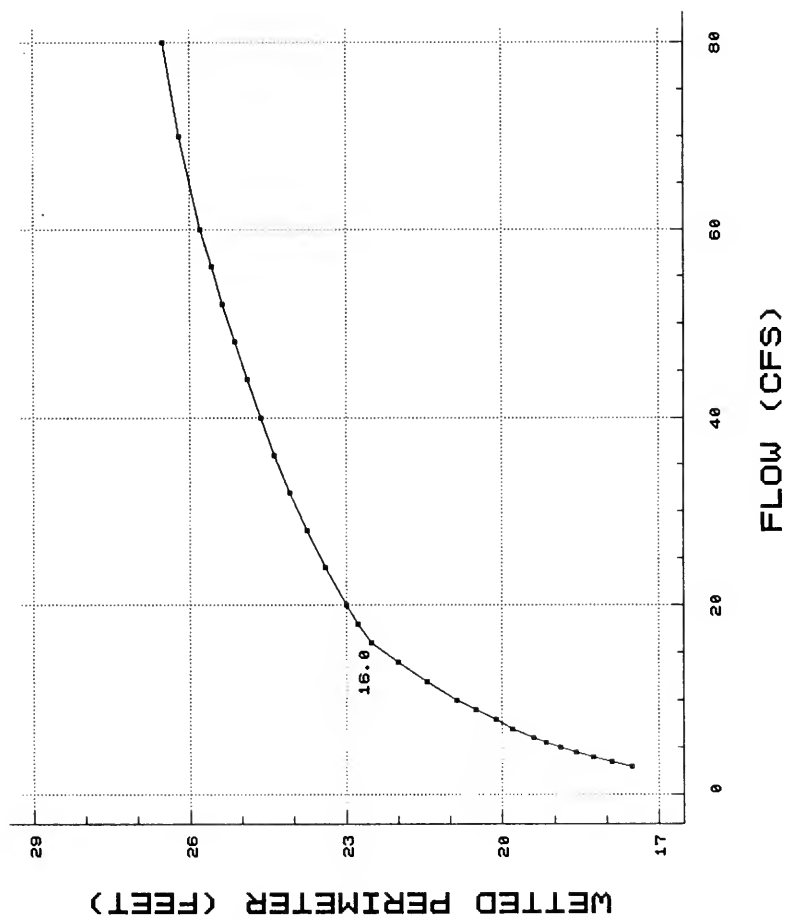


Figure 3-89. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Cottonwood Creek.

**STREAM NAME:** North Fork Musselshell River

**DESCRIPTION OF THE BASIN:**

The North Fork Musselshell originates on the south side of the Little Belt Mountains at an elevation of 7,000 feet. It flows south for approximately 11 miles before entering Bair Reservoir. From there the stream flows 16.5 miles in a southeasterly direction to its confluence with the South Fork Musselshell east of Martinsdale. Tributaries include Lion, Mill and Copper creeks above Bair Reservoir and Checkerboard, Trail, Flagstaff, Spring, Whetstone, Alkali and Gillis creeks in the lower section.

The upper section of the North Fork flows for 8 miles through a narrow mountain valley, then opens into a rolling sagebrush plain. Average stream gradient is 175 feet/mile in the upper 8 miles, flattening to 83 feet/mile in the 3 miles above Bair Reservoir. Below Bair Reservoir, the North Fork flows for about 6 miles through a narrow canyon and then opens into a wide valley. Average gradient in this section is 38 feet/mile.

A stream gauge located approximately 1 mile above Bair Reservoir was operated from 1940 to 1979. Maximum discharge measured at this gauge was 423 cfs recorded on April 1, 1950. Minimum discharge was 1.6 cfs on August 16, 1941. The average daily discharge for 36 years of record (1940-76) was 12.2 cfs (8,840 acre-feet/year).

Conifers provide the major riparian vegetation in the headwater region. These are replaced by cottonwoods and willows intermixed with grass hay meadows at the top of the foothill section, then sage, shrubby cinquefoil, willow and alder through most of the foothills. Below Bair Reservoir, willows constitute the major riparian cover. Substrate is predominately gravel and boulders in the upper section and silt towards the lower end.

Major land uses in the drainage include logging and recreation in the headwaters and grazing and hay production throughout most of the drainage. Land ownership is about 12% public (Lewis and Clark National Forest) and 88% private. Access is generally allowed along most of the stream. Access is provided to much of the headwater area by secondary Forest Service roads. A major highway follows the river for about 6 miles below Bair Reservoir.



Irrigation development is extensive throughout the North Fork Drainage. Water is diverted from Lions Creek, Mill Creek and the North Fork in the headwaters to irrigate approximately 400 acres of meadow hay and to fill a small reservoir approximately 4 miles downstream. Bair Reservoir is a 7,000 acre-feet, in-channel storage reservoir and is one of three major storage reservoirs in the Musselshell drainage. The North Fork below Bair Reservoir is used to transport water from the reservoir to downstream irrigators. There are numerous diversions and irrigation returns along the entire reach of the North Fork below Bair Reservoir. The extensive irrigation and agricultural development activities below Bair Reservoir have resulted in serious siltation problems in the lower end of the drainage.

**STREAM NAME:** North Fork Musselshell River

**STREAM REACH:** #1 From the headwaters to Bair Reservoir -- 11 miles

**LOCATION:** Sec. 35C, T12N, R9E to Sec. 27A, T10N, R9E

**GAME FISH PRESENT:** Brook trout, rainbow trout

**FISHERY:**

A 300-foot section of the North Fork approximately 1 mile upstream from Bair Reservoir (Sec. 22D, T10N, R9E) was sampled by electrofishing on October 6, 1987. Attached aquatic vegetation, overhanging riparian vegetation and large boulders provided good fish habitat throughout this section. Bottom substrate consisted of silt interspersed with large boulders. Stream width averaged approximately 14 feet.

The upper North Fork supports an excellent trout population for a stream of its size. Brook trout comprised 95% of the trout sampled. A few mottled sculpins were the only other fish seen. Electrofishing survey data are summarized in Table 3-97.

Table 3-97. Summary of electrofishing catch for 300 feet of the North Fork Musselshell River sampled October 6, 1987.

Species	Number Captured	Length Range (in.)
Brook trout	201	2.0 - 10.8
Rainbow trout	11	2.9 - 7.8

The two-pass method (Leathe 1983) was used to estimate the trout population in this section of stream (Table 3-98).

Table 3-98. Estimated trout population in 300 feet of the North Fork Musselshell River sampled October 6, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 300 ft.
Combined trout	2.0 - 10.8	215 ( $\pm$ 2)
Combined trout	$\geq$ 3	213 ( $\pm$ 2)
Combined trout	$\geq$ 6	64 ( $\pm$ 1)

Bair Reservoir, located at the lower end of this reach, provides a barrier to all fish movement from downstream. Bair Reservoir is planted with rainbow, and some of these fish probably move upstream out of the reservoir.

#### WILDLIFE:

Mule deer, white-tailed deer, elk, black bear, mountain lion and a few moose are the big game species found in the headwaters area. Mule deer and antelope inhabit the sage brush valley. Ruffed and blue grouse are found in the mountain area, with sage grouse in the valley. Other wildlife includes beaver, mink, muskrat, weasel, bobcat, coyote and various raptors. Extensive beaver dams at several locations along the stream provide good nesting and rearing habitat for Canada geese and several species of ducks. Sandhill cranes nest along the upper section of stream.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 220-foot section of the North Fork approximately 250 yards downstream from a road crossing (Sec. 22D, T10N, R9E). Five riffle cross sections were established in this section. The WETP computer program was calibrated to field data collected at flows of 1.8, 5.3, 7.1 and 9.6 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-90. Lower and upper inflection points occur at approximate flows of 1.5 and 3 cfs, respectively.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain this excellent trout population in its existing condition and to help protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

**FLOW REQUEST:**

January 1-December 31 -- 3 cfs (2,172 A.F./yr.)

# NORTH FORK MUSSELSHELL RIVER (reach 1)

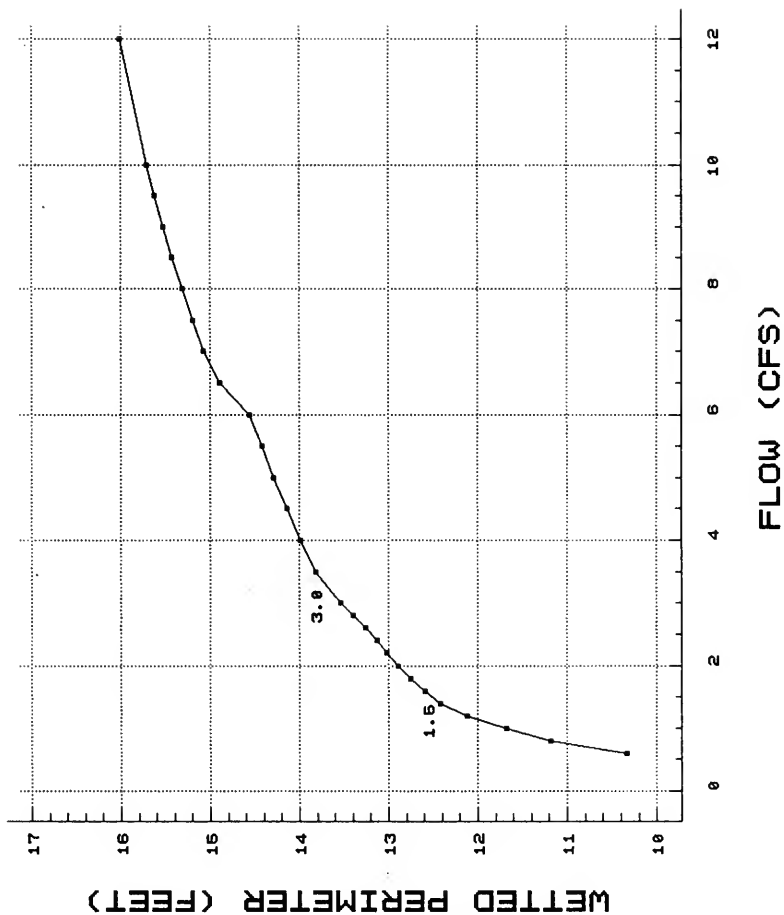


Figure 3-90. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 1 of the North Fork of the Musselshell River.

**STREAM NAME:** North Fork Musselshell River

**STREAM REACH:** #2. From Bair Reservoir to the confluence with the South Fork Musselshell River -- 16.5 miles

**LOCATION:** Sec. 35D, T10N, R9E to Sec. 6C, T8N, R12E

**GAME FISH PRESENT:** Brown trout

**FISHERY:**

A 500-foot section of the North Fork just upstream from Highway 12 (Sec. 2A, T8N, R11E) was electrofished on October 14, 1987. This section contained several well developed pools up to 4 feet deep connected by deep runs. Undercut banks and overhanging cover provided excellent fish habitat. Substrate consisted of a thick layer of fine sediment, much of it covered by filamentous algae. A second 300-foot section located approximately 7 miles further upstream (Sec. 30A, T9N, R11E) was sampled on June 8, 1988. Well-developed pools and overhanging vegetation again provided good fish habitat. Substrate consisted of sediment over cobbles, but sediment was not nearly as thick as in the lower section.

Brown trout were the only game fish collected. A total of 59 brown trout ranging from 3.2 to 18.6 inches total length were collected from both sections. A two-pass method (Leathe 1983) estimate made on the lower section determined there were 44 brown trout in this 500-foot section, with 25 brown trout greater than 6 inches long. Non-game species collected include mottled sculpin, longnose dace and longnose and white suckers.

Fisheries values in this reach of the North Fork have been seriously impacted by man's activities. Problems with water quality result from agricultural runoff and irrigation returns which cause increases in salinity, nutrient levels and sediment. These in turn contribute to high water temperatures and turbidity, while lowering dissolved oxygen levels. Extreme sedimentation appears to be a major problem in the lower end of the reach, and releases from Bair Reservoir create a totally unnatural flow pattern in this reach of stream.

The lower North Fork appears to provide an important fishery for local anglers, but no pressure estimate is available. Access is good along most of the stream. Bair Reservoir located at the upper end of this reach provides a total barrier to upstream fish movement.

#### **WILDLIFE:**

Mule deer, white-tailed deer and antelope are the big game species found along this reach. Hungarian partridge is the principal game bird. Other wildlife include beaver, mink, muskrat, weasel, bobcat, coyote and various raptors. A variety of waterfowl species utilize the stream and the extensive network of irrigation canals in the valley for resting areas during migration and for nesting. Sandhill cranes also nest along this section of stream.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 450 section of the lower North Fork located approximately 1/2 mile upstream from Highway 12 (Sec. 2A, T8N, R11E). Five riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 9.5, 24.0 and 28.6 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in Figure 3-91. Lower and upper inflection points occur at approximate flows of 10 and 16 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the resident trout fishery at its present level, to help dilute the increased salinity and nutrient levels entering the stream and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 16 cfs (11,583 A.F./yr.)

# NORTH FORK MUSSELSHELL RIVER (reach 2)

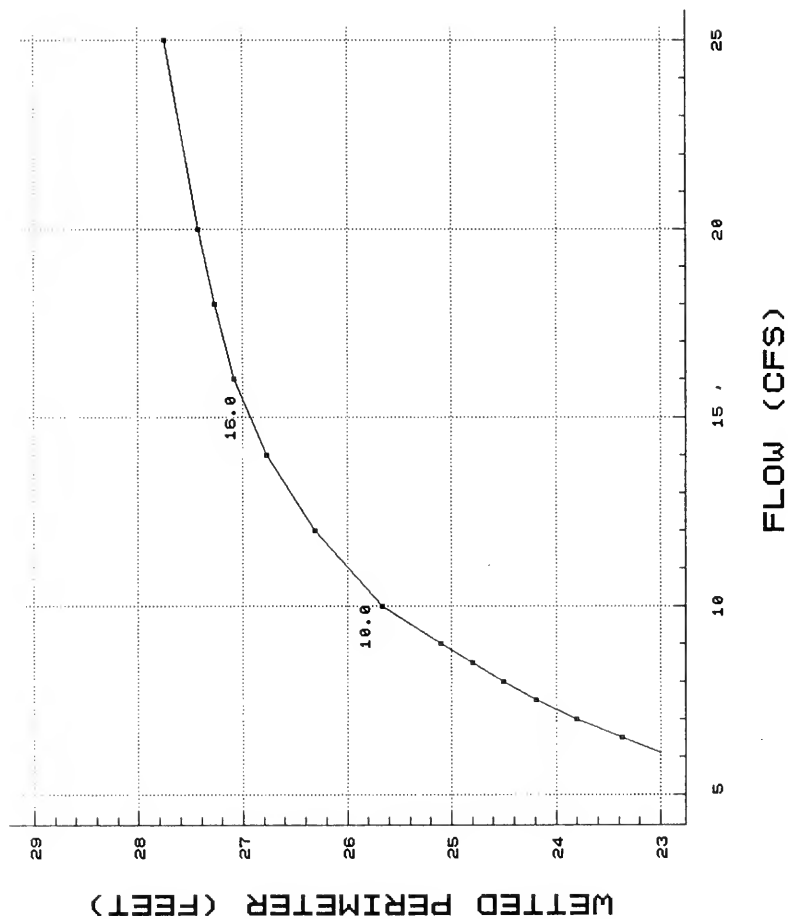


Figure 3-91. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Reach 2 of the North Fork of the Musselshell River.



**STREAM NAME:** Checkerboard Creek

**STREAM REACH:** From the confluence of the East and West forks to the mouth -- 6.5 miles

**LOCATION:** Sec. 13D, T9N, R8E, to Sec. 1B, T9N, R9E

**DESCRIPTION OF STREAM REACH:**

Checkerboard Creek originates on the north side of the Castle Mountains and flows northeasterly for about 6.5 miles before discharging into the North Fork of the Musselshell River at the town of Checkerboard. Major tributaries include Stohr Creek and Hall Creek. Numerous springs also contribute water in the upper drainage. A USGS gauge operated for nine years (1922-32) 1/2 mile above the mouth showed the mean annual flow to be 8.4 cfs.

Checkerboard Creek meanders through a narrow valley with steep ridges on both sides. Average gradient is about 110 feet/mile and stream width is about 10 feet. Substrate consists of gravel and silt. The riparian zone is well developed with a thick cover of willows, alder, water birch and rose bushes. Beaver activity is abundant and in some areas the stream becomes a series of beaver ponds. Vegetation on surrounding mountain ridges consists of conifer stands intermixed with natural grass parks.

Major land uses beyond the riparian area include grazing, limited hay production and recreation. Just above its mouth, Checkerboard Creek flows through the town of Checkerboard where numerous houses are built along the stream.

Land ownership in the drainage is about 50% private and 50% public (Lewis and Clark National Forest). Several jeep trails provide access to USFS land. Access with permission is allowed on some of the private land.

There are at least two irrigation diversions along the lower half of the stream. A diversion located approximately 1.5 miles upstream from the mouth causes serious dewatering in the lower end of the stream.

**GAME FISH PRESENT:** Brook trout, rainbow trout, brown trout

**FISHERY:**

A 450-foot section of Checkerboard Creek located just downstream from the lower corral at the abandoned 32 Bar Ranch (Sec. 4A & D, T9N, R9E) was sampled by electrofishing on October 28, 1987. The stream in this area meanders through a small natural meadow. Scattered overhanging brush, undercut banks, and pools up to 4 feet deep provide fish cover. Substrate is predominately silt with some attached aquatic vegetation. Some small gravel is exposed in riffle areas.

Checkerboard Creek supports an excellent trout population. Brook trout and rainbow trout over 12 inches long and brown trout over 16 inches long were captured. The fishery is comprised of 71% brook trout, 21% rainbow trout, and 8% brown trout. Electrofishing survey data are summarized in Table 3-99. Mottled sculpins are numerous and were the only other fish seen.

Table 3-99. Summary of electrofishing catch in 450 feet of Checkerboard Creek sampled October 28, 1987.

Species	Number Captured	Length Range (in.)
Brook trout	263	2.7 - 12.1
Rainbow trout	79	2.5 - 12.7
Brown trout	31	2.8 - 16.5

Results of a two-pass method (Leathe 1983) population estimate conducted on the same 450-foot stream section are presented in Table 3-100.

Table 3-100. Estimated trout populations in 450 feet of Checkerboard Creek sampled October 28, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Number per 450 feet
Brook trout	2.7 - 12.1	279 ( $\pm$ 9)
Rainbow trout	2.5 - 12.7	79 ( $\pm$ 1)
Brown trout	2.8 - 16.5	32 ( $\pm$ 2)
Combined trout	2.5 - 16.5	387 ( $\pm$ 7)
Combined trout	$\geq$ 6	113 ( $\pm$ 1)

#### **WILDLIFE:**

Big game species found in the drainage include mule and white-tailed deer, elk, black bear and mountain lion. Blue and ruffed grouse are the resident game birds. Furbearers include beaver, muskrat, mink, and bobcat. Coyotes and various raptors also use the area. Waterfowl use is very limited.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 100-foot section of Checkerboard Creek located in the canyon approximately 1 mile above the mouth (Sec. 2B, T9N, R9E). Four riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 3.3, 7.1 and 8.9 cfs.

The relationship between wetted perimeter and flow for a composite of the four riffle cross sections is shown in Figure 3-92. An upper inflection point occurs at an approximate flow of 6 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population in an already seriously dewatered stream, and to protect the habitat of those wildlife species present which depend on the stream and its riparian area for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 6 cfs (4,344 A.F./yr.)

# CHECKERBOARD CREEK

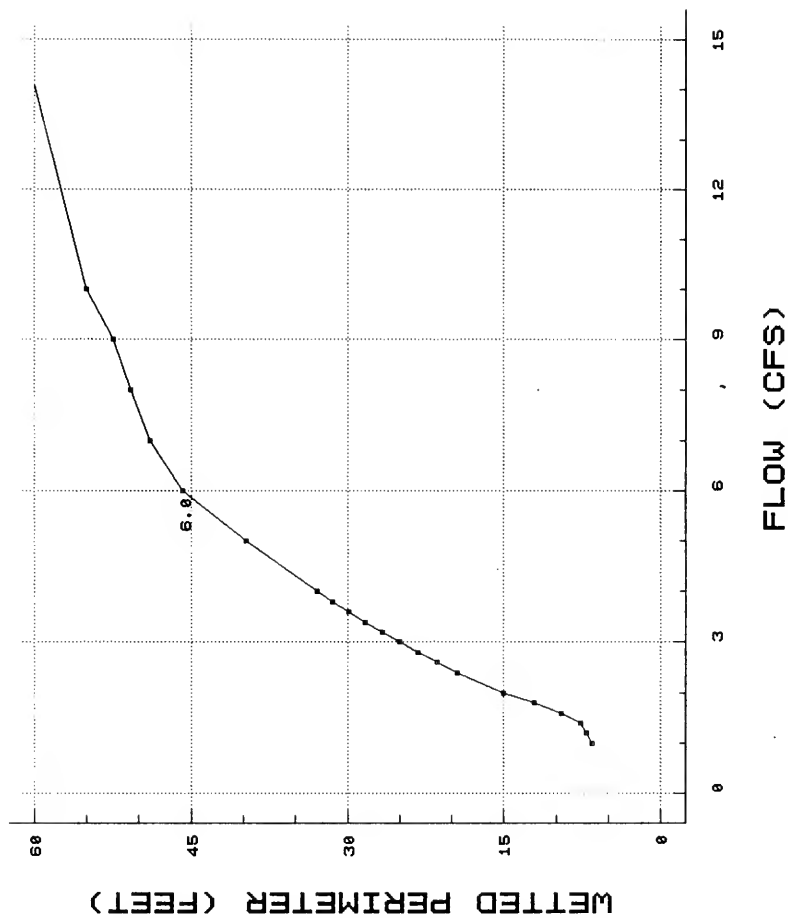


Figure 3-92. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Checkerboard Creek.

**STREAM NAME:** Spring Creek

**STREAM REACH:** From the headwaters to the mouth -- 12.5 miles

**LOCATION:** Sec. 33B, T11N, R11E to Sec. 15A, T9N, R10E

**DESCRIPTION OF STREAM REACH:**

Spring Creek originates near the southern edge of the Little Belt Mountains and flows southeast for 12.5 miles before discharging into the North Fork Musselshell River 5 miles below Bair Reservoir. Tributaries entering Spring Creek include Fawn, Basin, Whitetail and South Fork Spring creeks.

The upper 7.5 miles is a deeply entrenched, high gradient mountain stream. Stream width averages less than 10 feet. Substrate consists of cobbles and rubble with a few large boulders. Surrounding vegetation consists of a mature pine and spruce overstory.

The lower 5 miles of stream is less confined except for a narrow gorge about 1 mile above the mouth. Gradient decreases, stream width averages 15 feet and substrate changes to cobbles, gravel and silt. The riparian area is more defined, with willows and water birch providing the predominant riparian cover. Smaller shoreline vegetation has been greatly reduced by grazing. Mature cottonwood trees and several small hay meadows are found along the lower reach.

Flow in the lower 5 miles of stream is intermittent as the entire flow goes underground in some areas.

The upper 5.5 miles of stream passes through U. S. Forest Service (USFS) property. The lower reach flows through several parcels of private land intermixed with USFS property. Land uses include recreation, logging, grazing and hay production. The USFS maintains two designated recreation sites along the stream.

There is a significant accumulation of silt in the slower sections of stream, probably a result of logging and grazing activities. Some minor bank erosion occurs where cattle have been using the stream banks. A major USFS road parallels the lower 4 miles of Spring Creek, but has little direct effect on the stream. Access is provided as far up as Basin Creek by a secondary USFS road.

GAME FISH PRESENT: Brook trout, rainbow trout

FISHERY:

In early October, 1987, a 500-foot section just downstream of Whitetail Creek (Sec. 21, T10N, R10E) was sampled by electrofishing. This section consisted of a series of pools with a few interconnecting riffles. Overhanging brush and instream woody debris provided fish habitat. Substrate consisted of small cobbles and gravel covered by silt.

Spring Creek appears to provide an important trout fishery to local residents. Easy access on USFS land and the presence of two USFS camp sites along the stream make this an important recreational area. Angler sightings and the presence of a well used trail along the stream indicate substantial use on this small stream.

Table 3-101 presents a summary of electrofishing results. Brook trout constituted 88% of the total trout catch. Large numbers of sculpin were also seen.

Table 3-101. Summary of electrofishing catch in 500 feet of Spring Creek sampled October 7, 1987.

Species	Number Captured	Length Range (in.)
Brook trout	227	2.0 - 10.3
Rainbow trout	30	2.2 - 9.1

Table 3-102 presents results of a two-pass method (Leathe 1983) estimate of the trout populations in Spring Creek. For its size, this stream supports a substantial resident trout population.

Table 3-102. Estimated trout population in 500 feet of Spring Creek sampled October 7, 1987. (80% confidence intervals in parentheses.)

Species	Length Group (in.)	Numbers per 500 ft.
Brook trout	2.0 - 10.3	242 ( $\pm$ 8)
Rainbow trout	2.2 - 9.1	32 ( $\pm$ 3)
Combined trout	2.0 - 9.1	274 ( $\pm$ 9)
Combined trout	$\geq$ 6	52 ( $\pm$ 1)

Several redds were seen in the section while electrofishing. Five ripe male rainbow as well as numerous ripe brook trout were collected. The dewatered sections in the lower end of the stream act as complete barriers to migratory fish during normal summer and fall flow periods.

#### **WILDLIFE:**

Big game species using the area include mule and white-tailed deer, elk, black bear, moose and mountain lion. Game birds utilizing the drainage include ruffed and blue grouse. Other wildlife species include mink, bobcat, lynx, coyote, and various raptors. Little waterfowl use occurs on Spring Creek.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 400-foot section of Spring Creek located approximately 1/4 mile downstream from Whitetail Creek and just upstream from the fence separating USFS land from private land (Sec. 21A, T10N, R10E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 2.8, 7.9, and 13.4 cfs.

The relationship between wetted perimeter and flow for a composite of the five riffle cross sections is shown in Figure 3-93. Lower and upper inflection points occur at approximate flows of 2.5 and 8 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident trout population and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 8 cfs (5,792 A.F./yr.)

## SPRING CREEK

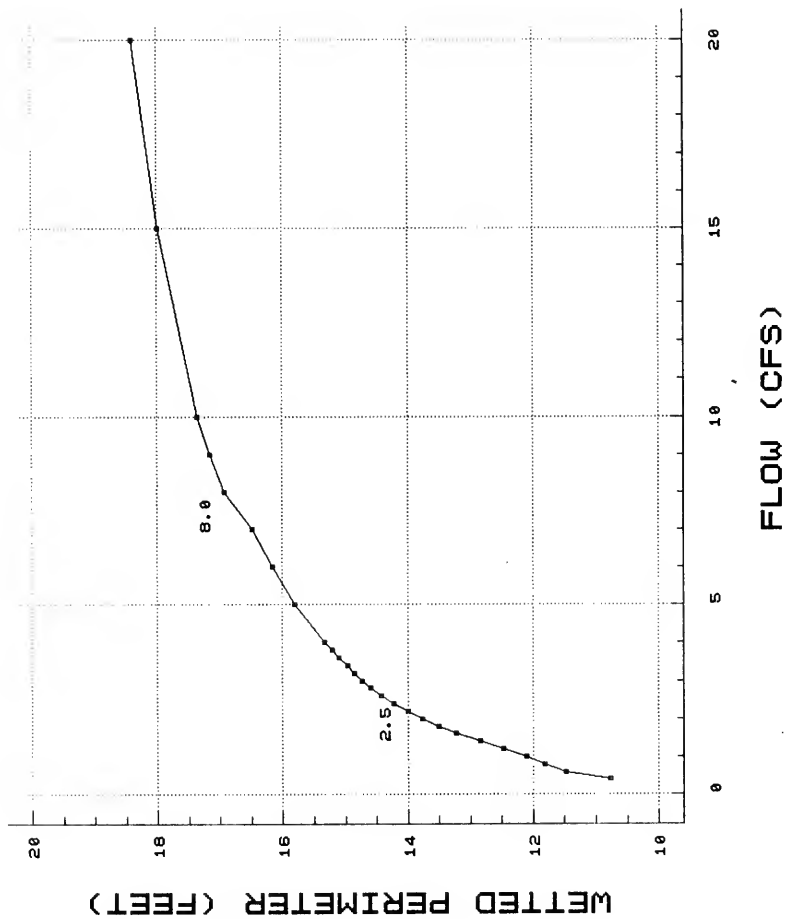


Figure 3-93. The relationship between wetted perimeter and flow for a composite of five rifle cross sections in Spring Creek.



**STREAM NAME:** Big Elk Creek

**STREAM REACH:** From its origin at the confluence of Lebo Fork to the mouth -- 28 miles

**LOCATION:** Sec. 1A, T5N, R11E to Sec. 26A, T8N, R13E

**DESCRIPTION OF STREAM REACH:**

Big Elk Creek is a moderate gradient, prairie trout stream flowing through mostly grazing land from its headwaters in the Crazy Mountains to its confluence with the Musselshell River at the town of Twodot. It has a drainage area of about 70 square miles. The streambed is mostly cobbles and gravel with good water quality and high water clarity, making it one of the most visually attractive streams in the region.

The riparian area is covered with dense willows and cottonwoods and provides high quality white-tailed deer habitat. The entire stream is on private land except in the extreme headwaters where private ownership is shared in a checkerboard fashion with the Gallatin National Forest. A county road closely parallels the stream for most of its length, making it very accessible to fishermen.

There are several small irrigation diversions along the stream which can impact flows substantially in a low runoff year.

**GAME FISH PRESENT:** Brook trout, brown trout

**FISHERY:**

The fishery is dominated by brook trout in the upper reaches and brown trout in the lower reaches. The entire stream is considered good to excellent fishing.

A two-pass method (Leathe 1983) population estimate was conducted in September, 1987 on a 500-foot reach of stream 1.5 miles upstream from the mouth. Brown trout were abundant, with an excellent distribution of sizes and fish up to 14 inches in length (Table 3-103). Growth rates are very good. No other game fish species were captured in this reach. White and longnose suckers and longnose dace were also abundant and mottled sculpins were commonly observed. A total of 130 brown trout less than 6 inches long (age 0) were sampled, indicating

excellent reproduction is occurring, although no number estimate was obtained. Brown trout from the Musselshell River may ascend Big Elk Creek in the fall to spawn.

Table 3-103. Estimated population of brown trout in Big Elk Creek, September, 1987. (80% confidence intervals in parentheses.)

Age Class	Number per 500 ft.	Average Length (in.)	Length Range (in.)
0	130*	3.8	2.5 - 4.9
1	49 ( $\pm$ 5)	7.8	6.1 - 9.3
2--]		11.0	9.8 - 12.4
3--]--combined--	26 ( $\pm$ 2)	13.0	11.7 - 13.7
4--]		14.1	13.8 - 14.3
Total			2.5 - 14.3

\* Minimum number based on actual count. Estimate could not be made.

Dewatering presents the greatest threat to the existing fishery. According to local reports, brown trout have successfully competed with brook trout and eliminated them in the lower reaches of the stream during recent years. Over 100 brown trout between 10 and 20 inches long were observed in one deep pool above a diversion dam when the streamflow was 4.8 cfs. Most of the stream did not appear to contain adequate depth or cover to provide secure habitat for adult fish at this flow.

There is no fishing pressure estimate available for this stream but fisherman use, particularly by local area anglers, is judged to be substantial.

#### WILDLIFE:

The headwaters of Big Elk Creek provide secure habitat for large numbers of white-tailed deer and elk. They are also used by beaver and mink. Pheasants utilize the lower corridor and mountain grouse occur in the headwaters. The stream provides habitat for mallards and other waterfowl. A diverse raptor population nests in and utilizes the stream corridor. Bald eagles are seasonally common.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 300-foot section of Big Elk Creek located about 1.5 miles upstream from the mouth at Twodot (Sec. 35B, T8N, R13E). Five riffle cross sections were established and four were used in the analysis. One cross section was not used due to calibration problems. The WETP program was calibrated to field data collected at flows of 4.8, 13.4, and 25.0 cfs.

The relationship between wetted perimeter and flow from a composite of four riffle cross sections is shown in Figure 3-94. Lower and upper inflection points occur at approximately 3 and 9.5 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout fishery and to provide spawning and rearing habitat for fish from the Musselshell River. As previously mentioned, an observed flow of 4.8 cfs in the study section provided extremely limited habitat for larger trout and forced most mature brown trout in the area to congregate in one deep pool. If the requested flow is maintained, Big Elk Creek will continue to provide a high quality fishery and the flow will help sustain flows downstream in the heavily-depleted Musselshell River. The requested flow will also help protect the habitat of those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 9.5 cfs (6,878 A.F./yr.)

# BIG ELK CREEK

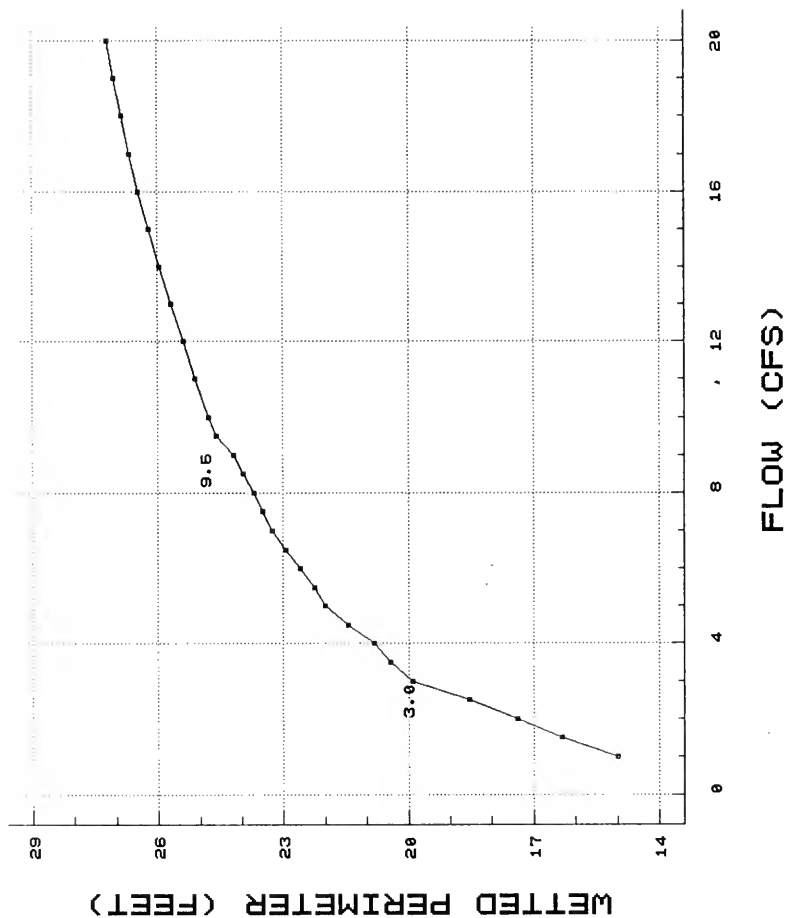


Figure 3-94. The relationship between wetted perimeter and flow for a composite of four riffle cross sections in Big Elk Creek.

**STREAM NAME:** American Fork Creek

**STREAM REACH:** From the confluence of the South Fork to the mouth - 38.7 miles

**LOCATION:** Sec. 11, T5N, R12E, to Sec. 33, T8N, R16E.

**DESCRIPTION OF STREAM REACH:**

American Fork Creek is a moderate-gradient, prairie trout stream which flows through grazing and agricultural land from its headwaters in the Crazy Mountains to its confluence with the Musselshell River about 6 miles east of Harlowton. It has a drainage area of 166 square miles. The largest tributary, Lebo Creek, enters just 6 miles upstream from the mouth and drains 59 square miles.

The streambed is gravel and cobbles with heavy silt loads in the lower reaches. Water clarity is high. The middle reaches of the stream go dry most years. Flow reemerges from underground aquifers and the lower 15 miles of the stream flows year-around.

The entire mainstem flows through private land, with open grazing land and scattered timber in the upper half and a well-developed willow-cottonwood riparian complex in the lower half. Most of the lower reaches are flanked by hay meadows. The entire stream is crisscrossed by county roads. Fisherman access is good.

Diversions of water irrigate about 7,500 acres, dewatering much of the stream during a normal summer. A gauge site 2 miles upstream from the mouth recorded a mean annual flow of 31 cfs during the 21-year period of record (1946-67). Mean monthly flows ranged from 11 cfs (August) to 130 cfs (June).

**GAME FISH PRESENT:** Brown trout, brook trout

**FISHERY:**

The fishery is dominated by brook trout in the upper reaches and brown trout in the lower reaches. Fishing is good in the stream sections that flow year round (upper and lower end) but only poor to fair in the dewatered (middle) reaches.

A two-pass method (Leathe 1983) population estimate was conducted in September, 1987, on a 1,000-foot reach of stream approximately 8 miles upstream from the mouth. Brown trout were abundant with a wide distribution of ages and sizes up to 14 inches long (Table 3-104). Five brook trout from 3-10 inches were captured but no estimate was made. White and longnose suckers and longnose dace were also abundant throughout the reach.

Overall, the brown trout population is fair but does not appear to be as high as it should be given the habitat conditions. Age 1 and older brown trout were estimated at 34/1,000 feet of stream as compared to 150/1,000 feet on the similarly-sized and adjacent Big Elk Creek, which generally suffers less dewatering. Annual dewatering is probably a limiting factor for this fishery.

This stream is an important local fishery. Also, brown trout from the Musselshell River could potentially migrate into the lower reaches during the fall spawning season.

Table 3-104. Estimated population size and ages of brown trout in American Fork Creek from electrofishing samples collected on September 9, 1987.

Age Class	Number per 1,000 ft.	Average Length	Length Range
0	40 ( $\pm$ 2)	3.8	3.0 - 4.7
1	18 ( $\pm$ 1)	8.5	7.2 - 9.7
2-4	16 ( $\pm$ 9)	10.8	10.4 - 13.6
Total	74 ( $\pm$ 12)	6.5	3.0 - 13.6

#### WILDLIFE:

American Fork Creek provides secure habitat for elk in the headwaters and white-tailed and mule deer throughout its length. Swampy areas in the lower reaches are heavily dammed by beaver and are also utilized by mink and other furbearers. Pheasants and sharp-tailed grouse frequent the lower corridor and mountain grouse occur in the headwaters. The stream and beaver ponds provide habitat for mallards and other waterfowl. A diverse raptor population nests in and utilizes the stream corridor and bald eagles are seasonally common.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 200-foot section of American Fork Creek located about 8 miles upstream from its confluence with the Musselshell River (Sec. 14D, T7N R15E). Five riffle cross sections were established. The WETP program was calibrated to field data collected at flows of 3.1, 4.1, and 65.3 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in Figure 3-95. Lower and upper inflection points occur at flows of approximately 2.5 and 5.5 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to provide habitat, food, and cover to maintain the trout population in American Fork Creek. If this flow is maintained, the existing fishery will be protected and flows will be supplemented in the heavily-depleted Musselshell River. The requested flow will also help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 5.5 cfs (3,982 A.F./yr.)

# AMERICAN FORK CREEK

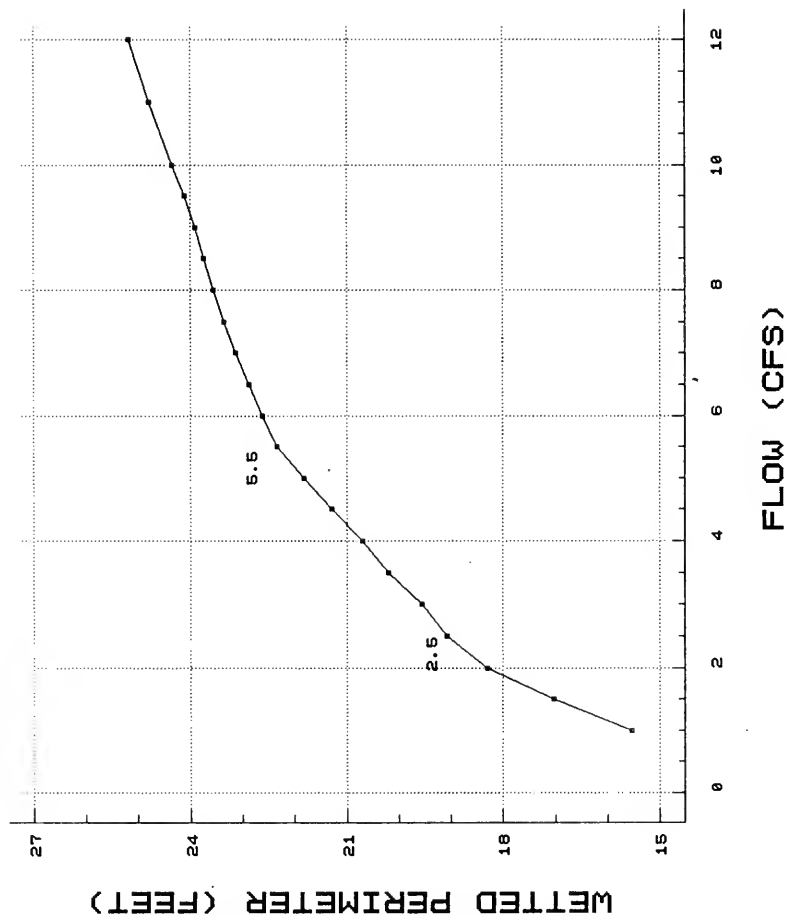


Figure 3-95. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in American Fork Creek.



**STREAM NAME:** Careless Creek

**STREAM REACH:** From the headwaters to the confluence of Roberts Creek -- approximately 36 miles

**LOCATION:** Sec. 36, T12N, R18E to Sec. 16, T8N, R18E.

**DESCRIPTION OF STREAM REACH:**

Careless Creek is a small brook trout stream which flows through grazing and agricultural land from its headwaters in a steep timbered canyon in the Snowy Mountains to its confluence with the Musselshell River about 4 miles east of Ryegate. Little Careless Creek (mile 47.9), Roberts Creek (mile 37.9) and Swimming Woman Creek (mile 22.3) are the major tributaries. Additionally, a large amount of irrigation tailwater from Deadmans Diversion is discharged into Careless Creek at mile 18.5 during the summer months.

The upper 30 miles of stream flows through a well-developed riparian zone containing beaver dams. Water quality is good, with a cobble and gravel substrate and a moderate gradient.

The middle reaches of the stream have a lower gradient, generally gravel or sand substrate, and flow through open grazing and agricultural land within a narrow riparian zone. This section of the stream dries up during most summers due to irrigation depletion; major tributaries are dry as well. The lower reach boundary lies in this stream section.

The lower 18.5 miles of the stream downstream from the Deadmans Diversion discharge suffers from severely degraded habitat conditions. A low-gradient deeply-incised channel and severe erosion problems are due to the unnaturally high flows discharged from the diversion. These discharges are high in nutrients and sediment (averaging up to 40 tons/day) and result in severe degradation of Musselshell River water quality from the mouth of Careless Creek downstream. This is the most severe water quality problem in the entire Musselshell River drainage. This section of the stream is, therefore, excluded from the instream flow request.

The entire stream flows through private lands with the exception of the extreme headwaters (3 miles) which are in the Lewis and Clark National Forest. The stream is crisscrossed by numerous county roads and access is good.

**GAME FISH PRESENT:** Brook trout

**FISHERY:**

At the present time only about the upper 1/2 of the entire stream supports a viable fishery. Stream dewatering and water quality problems have eliminated the fishery in the lower half of Careless Creek. The brook trout fishery is considered good in the upper half of the stream.

A two-pass method (Leathe 1983) population estimate was conducted in a 500-foot section of Careless Creek about 1 mile downstream from the confluence of Little Careless Creek. This is near the lower end of the perennial flow and probably represents a low estimate of the population. More fish probably are present further upstream.

During the two electrofishing passes a total of 347 brook trout less than 5 inches long were collected but no estimate was obtained. Fish longer than 5 inches were estimated at 188/1,000 feet of stream. Brook trout up to 11 inches long were captured. Longnose dace were abundant and white suckers common.

The upper end of Careless Creek is an important local fishery. With improvements in water quantity and quality, the value of this fishery would improve and extend considerably further downstream.

**WILDLIFE:**

Careless Creek provides high-quality riparian habitat for white-tailed and mule deer, particularly in the upper reaches. Common furbearers include beaver, muskrat, mink, raccoon and bobcat. Blue, ruffed and sharp-tailed grouse, turkeys and pheasants inhabit the riparian corridor. The beaver ponds in the upper reaches provide some waterfowl habitat and numerous raptors nest on the stream corridor.

**WETTED PERIMETER:**

Cross-sectional data were collected in a 175-foot section of Careless Creek located about 1 mile downstream from the confluence of Little Careless Creek (Sec. 7A, T9N, R18E). Five riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 0.9, 1.4, and 5.4 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in Figure 3-96. An upper inflection point occurs at an approximate flow of 2.0 cfs.

**WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing resident brook trout population in the upper reaches of Careless Creek, and help protect the habitat of those wildlife species present which depend on the stream and its riparian zone for food, water and shelter. Maintenance of this flow in all reaches throughout the year would extend the range of the existing fishery downstream.

**FLOW REQUEST:**

January 1-December 31 -- 2 cfs (1,448 A.F./yr.)

# CARELESS CREEK

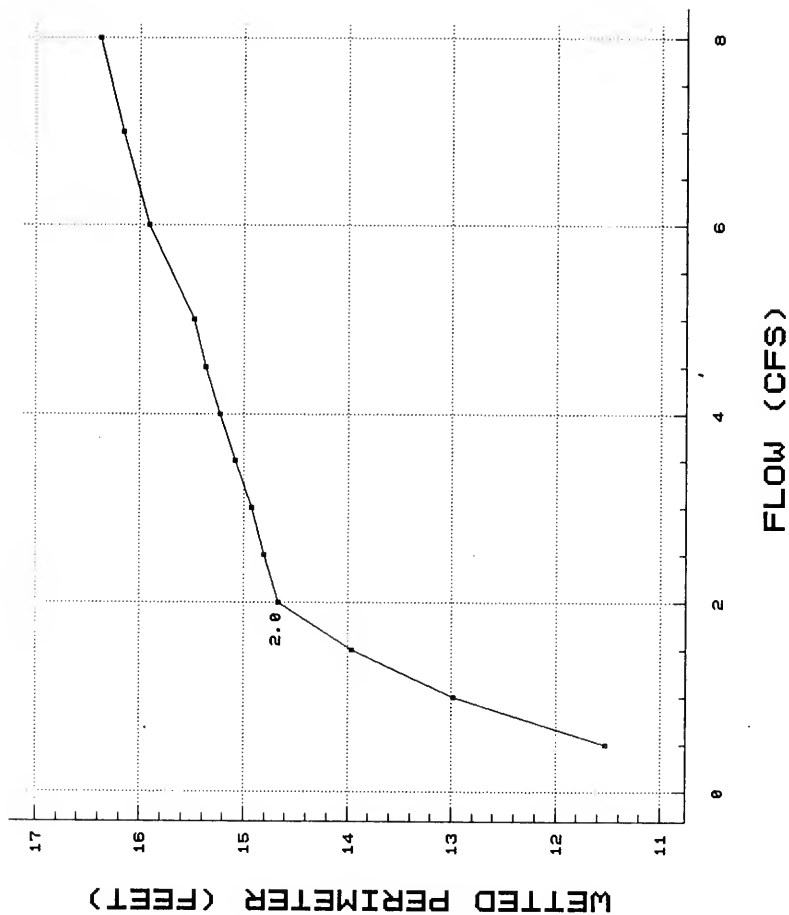


Figure 3-96. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Careless Creek.

**STREAM NAME:** Swimming Woman Creek

**STREAM REACH:** From the headwaters to the county road crossing 8 linear miles upstream from the mouth -- approximately 30 miles

**LOCATION:** Sec. 32, T12N, R19E, to Sec. 3, T8N, R19E

**DESCRIPTION OF STREAM REACH:**

Swimming Woman Creek is a small brook trout stream which flows through grazing and agricultural land from its headwaters in a steep, timbered canyon in the Snowy Mountains to its confluence with Careless Creek about 7 miles northwest of Ryegate. There are no major tributaries to this stream.

The stream habitat in the upper 2/3 of the reach consists of a gravel bottom with dense cottonwood-willow cover. The lower 1/3 portion of the stream is lower gradient, has a sandy and silty substrate and meanders through open prairie. The upper reaches contain some beaver dams. The lower reaches are frequently dewatered by irrigation withdrawals. The stream reach boundary is located approximately where the habitat change occurs.

The stream originates in the Lewis and Clark National Forest with all but the upper 6 miles flowing through private land. A series of county roads closely parallel the stream and access is good.

**GAME FISH PRESENT:** Brook trout

**FISHERY:**

The entire stream supports a brook trout fishery. However, the lower reaches are frequently dewatered, and consequently, are generally poor fishing. Due to the small size of this stream, much of the fishery is concentrated in portions of the stream which are heavily beaver-dammed.

A two-pass method (Leathe 1983) population estimate was conducted on a 500-foot section of Swimming Woman Creek about midway down its length (approximately 22 miles from either end). The stream in this reach generally flows year-around.

A total of 108 brook trout between 2.1 and 4.9 inches were collected, indicating adequate reproduction occurs. No valid number estimate was possible for this size range. Fish longer than 5 inches were estimated at 153/1,000 feet of stream. Brook trout to 9.3 inches long were captured. Longnose dace and white suckers were abundant and lake chubs and fathead minnows were commonly observed.

Swimming Woman Creek is an important local fishery. Improvements in instream flow would enhance this fishery, particularly on the lower reaches of the stream.

#### **WILDLIFE:**

Swimming Woman Creek provides high-quality riparian habitat for white-tailed and mule deer, particularly in the upper reaches. Common furbearers include beaver, muskrat, mink, raccoon, and bobcat. Blue, ruffed, sage and sharp-tailed grouse and pheasants inhabit the riparian corridor. Beaver ponds in the upper reaches provide limited waterfowl habitat and numerous raptors nest in the stream corridor.

#### **WETTED PERIMETER:**

Cross-sectional data were collected in a 250-foot section of Swimming Woman Creek located about midway between the headwaters and the mouth (Sec. 16C, T9N, R19E). Five riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 0.7, 1.9, and 11.3 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in Figure 3-97. Lower and upper inflection points occur at approximate flows of 1.5 and 2.5 cfs, respectively.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the exiting resident brook trout population in the upper reaches of Swimming Woman Creek and help protect the habitat of those wildlife species present which depend on the stream and its

riparian zone for food, water and shelter. Maintenance of this flow throughout the year would improve the existing fishery in the frequently dewatered downstream reaches.

**FLOW REQUEST:**

January 1-December 31 -- 2.5 cfs (1,810 A.F./yr.)

# SWIMMING WOMAN CREEK

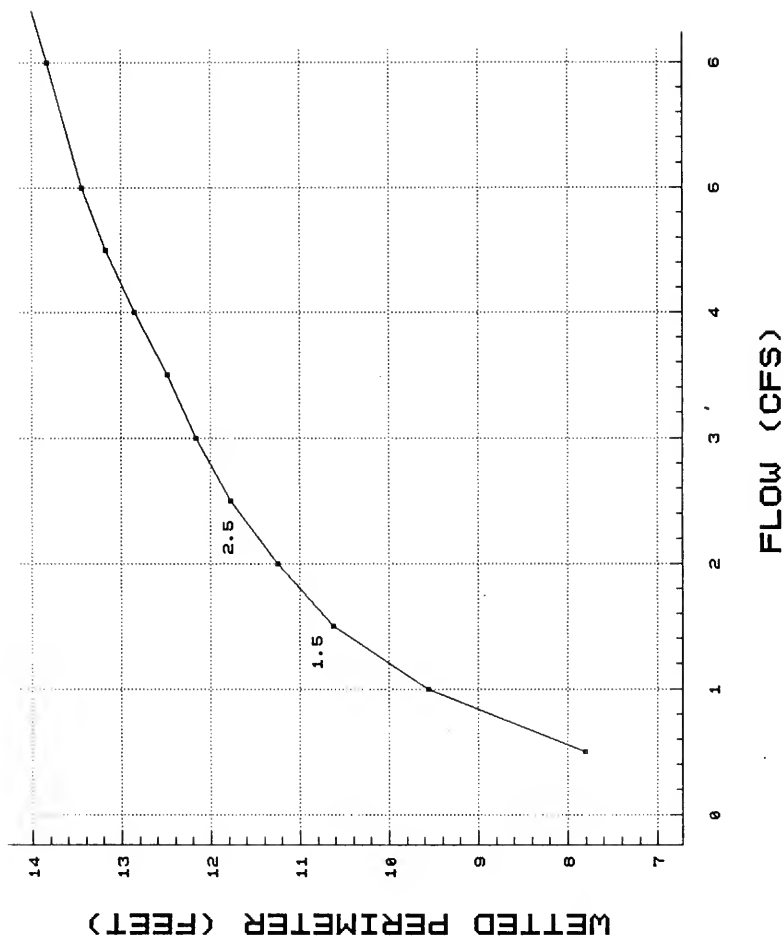


Figure 3-97. The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Swimming Woman Creek.



**STREAM NAME:** Collar Gulch Creek

**STREAM REACH:** From headwaters to the mouth -- 7 miles

**LOCATION:** Sec. 29, T17N, R20E to Sec. 8, T16N, R21E

**DESCRIPTION OF STREAM REACH:**

Collar Gulch Creek originates in the Judith Mountains about 12 miles northeast of Lewistown (Figure 3-98). This small stream flows southeast for about 7 miles to its confluence with Fords Creek. The upper 3.5 miles, which flows through a steep, narrow, timbered canyon, is the only section with a perennial flow. The lower 4 miles goes underground and has intermittent flow from the mountain face to Fords Creek. The upper stream has clear water with a gravel substrate.

Of the upper 3.5 miles, 60% is administered by the BLM and 40% is private. The lower 4 miles are 25% state land and 75% private. The riparian zone is vegetated with conifers, water birch, willows, chokecherry, aspen, and cottonwoods. Current and historical land use is livestock grazing. Access is via a 4x4 trail from the top of the Judith Mountains, which then follows the stream to the mountain face.

Portions of the mountainous riparian zone were subjected to past gold exploration and mining activities. A grayish-white precipitate coats the stream bottom in the upper mile of stream. This precipitate is probably mining related. The upper 1.5 miles of stream is blocked by a 4-foot log crib barrier, a remnant of past mining activity. This structure prohibits upstream fish movement.

**GAME FISH PRESENT:** Westslope cutthroat trout

**FISHERY:**

Stream trout populations in the Judith Mountains are rare. This stream contains a resident cutthroat population of unknown origin. Limited electrofishing in the stream in the late 1970s produced cutthroat trout which were moved upstream above the log crib barrier. Electrophoretic analysis determined that this population consists of pure strain westslope cutthroat trout (Leary and Allendorf 1981) which is a "Species of Special Concern" in Montana. They have survived in the isolated perennial headwaters of the stream for many



years. No population estimates were made, but fish range in length up to about 10 inches.

#### **WILDLIFE:**

The Collar Gulch Creek riparian zone supports populations of mule deer, white-tailed deer, cougar, and an occasional elk and black bear. Upland game birds in the upper drainage are ruffed and blue grouse, while sharp-tailed grouse, wild turkey, Hungarian partridge, and ring-necked pheasant are found in the lower drainage. Furbearers include bobcat, beaver, coyote, mink, muskrat, and weasel.

#### **WETTED PERIMETER:**

The wetted perimeter method was not used on Collar Gulch Creek. This stream was not originally scheduled for inclusion in this application. However, laboratory data on the genetic traits of the Westslope cutthroat trout residing in the stream are the basis for inclusion here. There was insufficient time to conduct wetted perimeter studies on the stream.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing, genetically-pure resident westslope cutthroat trout population and to help protect the habitat for those wildlife species present which depend on the stream and its riparian zone for food, water, and shelter.

#### **FLOW REQUEST:**

January 1-December 31 -- 0.6 cfs (434 A.F./yr.)

A flow recommendation derived from the wetted perimeter method is unavailable for Collar Gulch Creek. The instream flow request is, therefore, based on the fixed percentage method described in Volume 1. Under this method, 44% of the average annual flow is being requested for those Musselshell River tributaries having high fishery values. An average annual flow of 1.4 cfs was estimated by the USGS for Collar Gulch Creek. An instream flow of 0.6 cfs is, therefore, requested.

**STREAM NAME:** Flatwillow Creek

**STREAM REACH:** From the confluence of the North and South forks to Petrolia Reservoir -- 86 miles

**LOCATION:** Sec. 35, T13N, R22E to Sec. 36, T14N, R27E.

**DESCRIPTION OF STREAM REACH:**

Flatwillow Creek is the largest drainage emerging from the Snowy Mountains. From the confluence of the North and South forks, which originate in the Lewis and Clark National Forest, it flows eastward across a thick willow bottom through hay meadows and private grazing lands. Approximately half of the drainage is public (BLM) land but the stream corridor is almost exclusively on private lands. The stream is low-gradient with wide meanders and considerable beaver activity. It flows mostly clear in the upper reaches but carries a heavy silt load during spring runoff. Typical stream substrate is composed of sand and gravel.

Major tributaries are absent from this reach. Petrolia Reservoir, the downstream reach boundary, is an on-stream storage project which floods about 150 acres at the confluence of Flatwillow and Yellow Water creeks. It effectively isolates the upper reach of Flatwillow Creek from the rest of the drainage since no fish passage is possible.

There is a USGS gauging station near the community of Flatwillow, which is 55 miles upstream from Petrolia Reservoir and 31 miles downstream from the confluence of the forks. The period of record is 44 years (1911-56). In the 19 years prior to major water diversion activity, the mean annual flow was 46.2 cfs (1911-30) with monthly means ranging from 20 cfs (September) to 115 cfs (June). Following the establishment of major diversions (presently irrigating about 9,000 acres) the mean annual flow dropped to 14.3 cfs (1930-56) with monthly means of 2.4 cfs (September) to 53 cfs (June). This gauging site is approximately midway through the reach of stream supporting trout populations.

Upstream from the crossing of U.S. Highway 87, Flatwillow Creek is closely paralleled by a major county road with walk-in access across private lands. Downstream from U.S. 87 (the lower half of the reach) the fishery is degraded by sedimentation, water depletion, and irrigation return flows and, although accessible by several roads, is less heavily-used by fishermen.

**GAME FISH PRESENT:** Brown trout, rainbow trout, brook trout

**FISHERY:**

Flatwillow Creek is the best stream fishery in a large area covering Petroleum County and the surrounding locale. The North and South forks are narrow, brushy, beaver-dammed brook trout streams. The mainstem of Flatwillow Creek is a high-quality trout stream with abundant habitat which includes numerous pools, beaver dams, log jams and riffle-run sequences. The downstream portions of this reach (below U.S. Highway 87) have less summer flow, poorer water quality and a narrower riparian zone. Consequently the fishery rapidly deteriorates.

The fish population was surveyed in a 3,500-foot section of Flatwillow Creek during October 9-16, 1987. The electrofishing section was located near Tyler in the highest quality portion of the stream (Sec. 5, T12N, R23E). Survey results are summarized in Table 3-105. Game fish species present (in order of abundance) were brown trout, rainbow trout, and brook trout. White suckers, longnose suckers, longnose dace, lake chubs, and mottled sculpins were observed but not enumerated.

Table 3-105. Summary of electrofishing survey data collected in 3,500 feet of Flatwillow Creek in October, 1987.

Species	Number Captured	Length Range (in.)
Brown trout	152	4.2 - 24.1
Rainbow trout	54	7.9 - 16.6
Brook trout	14	5.2 - 11.1

The standing crop of trout in the section was estimated using a mark-recapture method (Table 3-106). The estimate showed 54 trout per 1,000 feet of stream having a biomass of 47 pounds. The population was about 3/4 wild brown trout and 1/4 hatchery-stocked rainbow trout. Small numbers of brook trout were present but were too few to estimate.

Table 3-106. Estimated standing crops of trout in 3,500 feet of Flatwillow Creek in October, 1987. (80% confidence intervals in parentheses.)

Species	Length group (in.)	Per 1,000 ft.	
		Numbers	Pounds
Brown trout	6.5 - 24.4	40 ( $\pm 4$ )	38 ( $\pm 6$ )
Rainbow trout	7.5 - 16.9	14 ( $\pm 2$ )	9 ( $\pm 2$ )

The population is comprised of a relatively low density of large, fast-growing, well-conditioned trout. This is suggestive of a population that is not being heavily exploited but which has limited reproduction. Many of the larger brown trout captured were in spawning condition, indicating that spawning occurs in this section of stream. However, a relatively low density of small fish was observed which suggests that the heavily-silted substrate may not be conducive to good survival of trout embryos.

Upper Flatwillow Creek is a high-quality trout fishery that assumes regional importance. Reduction of siltation, improved instream flow conditions, and better water management would extend the high quality fishery further downstream.

#### WILDLIFE:

Flatwillow Creek provides high-quality riparian habitat for white-tailed and mule deer. Common furbearers include beaver, muskrat, mink, raccoon, and bobcat. Ruffed and sharp-tailed grouse, pheasants and Hungarian partridge inhabit the riparian corridor. The bottomland is extensively used by nesting mallards and other waterfowl, and numerous beaver ponds provide migratory stopover areas. Raptors also inhabit the area.

#### WETTED PERIMETER:

Cross-sectional data were collected in a 150-foot section of Flatwillow Creek located near Tyler at the upper end of the reach (Sec. 5C, T12N, R23E). Five riffle cross sections were established. The WETP computer program was calibrated to field data collected at flows of 15.0, 29.0, and 38.1 cfs.

The relationship between wetted perimeter and flow from a composite of the five riffle cross sections is shown in

Figure 3-99. An upper inflection point occurs at an approximate flow of 18.0 cfs.

#### **WHY FLOW IS NECESSARY:**

The requested flow is necessary to maintain the existing trout fishery in Flatwillow Creek which is the highest quality trout stream in a wide geographic area. It will also help maintain the high-quality riparian habitat which is necessary to provide food, water and shelter for several wildlife species.

#### **FLOW REQUEST:**

January 1-December 31 -- 18.0 cfs (13,031 A.F./yr.)

Due to high diversion demands since 1930, the requested flow of 18.0 cfs exceeds the gauged mean annual flow for the 1930-56 period of record (14.3 cfs). However, mean annual flow prior to 1930 (1912-30 period of record) was 46.2 cfs with the lowest mean monthly flow equal to 20 cfs. Thus, the requested flow more nearly approaches natural conditions and is necessary to protect this high-quality stream ecosystem.

# FLATWILLOW CREEK

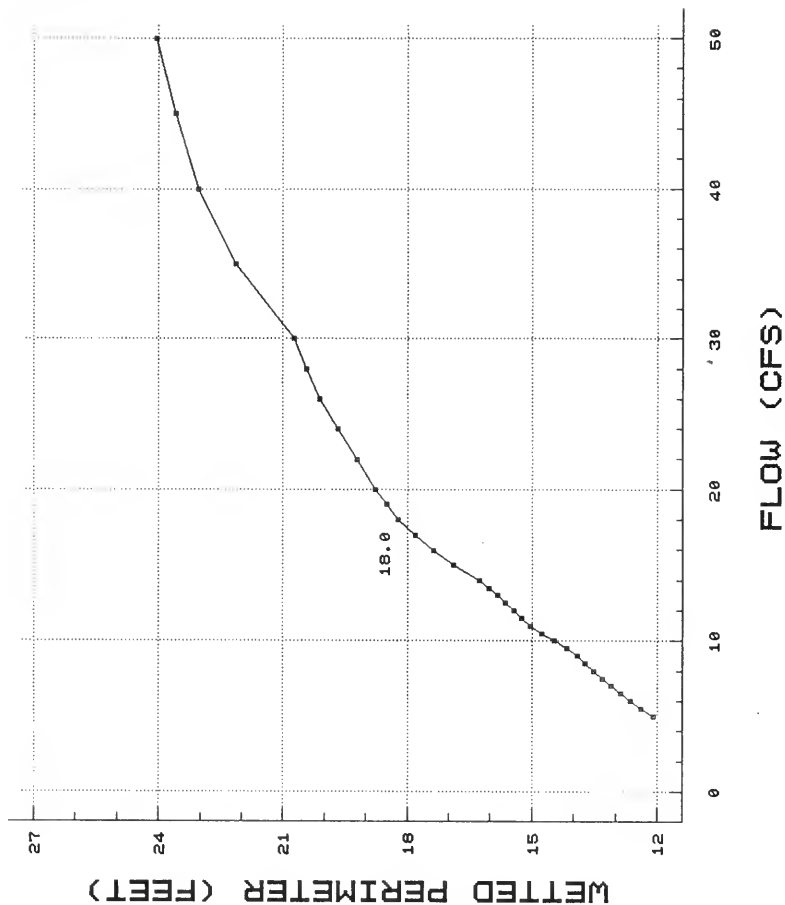


Figure 3-99.

The relationship between wetted perimeter and flow for a composite of five riffle cross sections in Flatwillow Creek.



## Big Dry and Little Dry Creek Drainages

The following streams are discussed in this section. They can be located on the map in Figure 3-1.

Big Dry Creek  
Little Dry Creek



**STREAM NAME:** Big Dry Creek

**STREAM REACH:** From the highway 200 bridge to the mouth -- 30 miles

**LOCATION:** Sec. 9D, T18N, R40E to Sec. 7A, T21N, R43E

**DESCRIPTION OF STREAM REACH:**

Big Dry Creek originates in the rolling prairie hills of central Garfield County in northeast Montana and flows easterly and northerly into the Big Dry Arm of Fort Peck Reservoir. This is a typical ephemeral prairie stream in eastern Montana, with low gradient and predominantly silty substrate, occasionally interspersed with gravel beds. Riparian habitat is very limited due to heavy grazing by livestock. Big Dry Creek drains more than 2,500 square miles, and is subject to severe flash flooding during rapid snow melt or heavy rains. Little Dry Creek is the only major tributary.

Land ownership along Big Dry Creek is almost 100% private, but the basin drains some BLM and state land. State highway 200 and the Haxby Point road parallel Big Dry Creek for most of its length. Access to the stream is generally granted with permission. Grazing and hunting are the major land uses within the basin.

A USGS gauge located on Big Dry Creek 900 feet downstream from the confluence of Little Dry Creek has been in operation for 44 years (1939-47, 1949-68 and 1970-87). The average annual flow during this period was 54 cfs (38,990 acre-feet/year). Extreme flows ranged from 24,600 cfs in March 1947 to no flow at times during most years.

**GAME FISH PRESENT:** Channel catfish, walleye

**FISHERY:**

Permanent resident fish populations in Big Dry Creek are limited due to intermittent flows, but pools apparently can sustain some species including channel catfish, white suckers and carp.

In spite of the ephemeral nature of this stream, sampling with larval fish nets and beach seines in 1979 demonstrated that Big Dry Creek is a crucial spawning and nursery area for many species of fish residing in Fort Peck Reservoir. Adult

walleye ascend the first 30 to 35 miles of Big Dry Creek to spawn on gravel bars when spring flows are sufficient to allow passage from Fort Peck Reservoir. Spring runoff in the drainage is seldom of sufficient magnitude, or of correct timing, to coincide with the annual spring walleye spawning run. However, in years when walleye are able to ascend the stream, as occurred in 1978 and 1979, a good walleye year class is produced. Walleye eggs, larvae and young-of-the-year fingerlings were collected in the lower reaches of the stream.

Seining in Big Dry Creek also captured young-of-the-year channel catfish, white and shorthead redhorse suckers, river carpsuckers and carp. Several minnow species were also found.

#### **WILDLIFE:**

Big game animals found in the Big Dry Creek drainage include antelope, mule deer and white-tailed deer. Resident game birds include sharp-tailed grouse, sage grouse, Hungarian partridge and turkey. Cottonwood trees near the mouth provide habitat for a commorant rookery and for Canadian geese nesting. There is some waterfowl use on the stream throughout the ice-free period.

#### **WETTED PERIMETER:**

Attempts to utilize the wetted perimeter method on Big Dry Creek were unsuccessful. Five transects were established near the USGS gauge site and stage data were collected at flows of 1.8 and 56 cfs. Because of the stream's low gradient and shifting channel conditions during runoff events, the data were not usable. The wetted perimeter method is not always adaptable to prairie stream conditions.

#### **WHY FLOW IS NECESSARY:**

The requested spring flows are necessary to provide spawning flows for walleye during years when runoff coincides with the spawning run from Fort Peck Reservoir. The flows requested during the remainder of the year are necessary to provide some flow between pools in the creek channel during the summer and fall to help maintain resident fish populations and young-of-the-year migratory game fish which rear in the stream. These flows will also help protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

**FLOW REQUEST:**

March 15 - March 31	--	300 cfs	( 9,521 A.F.)
April 1 - April 31	--	100 cfs	( 5,950 A.F.)
May 1 - May 31	--	35 cfs	( 2,152 A.F.)
June 1 - October 31	--	5.5 cfs	( <u>1,669 A.F.</u> )

19,292 A.F./yr.

The basis for the requested flows is the Water Availability Study prepared by the USGS for this site (see Appendix A in Volume 1). Mean monthly flows are being requested from March 15 through May 31 to provide reasonably high flows during the walleye spawning period. The 50th percentile flow is being requested for the remainder of the summer and fall. This flow will be available 5 out of 10 years on the average and should be high enough to maintain some flow between pools to maintain resident and rearing migratory fish.

**STREAM NAME:** Little Dry Creek

**STREAM REACH:** From Whiteside ranch house to the confluence with Big Dry Creek -- approximately 8 miles

**LOCATION:** Sec. 7A, T17N, R43E to Sec. 4A, T18N, R42E

**DESCRIPTION OF STREAM REACH:**

Little Dry Creek originates in the rolling prairie hills of northeastern Garfield County in northeast Montana and flows northerly into Big Dry Creek. This is a typical ephemeral prairie stream in eastern Montana, with low gradient and predominantly silty substrate, occasionally interspersed with gravel beds. Riparian habitat is very limited due to heavy grazing by livestock. Little Dry Creek is subject to severe flash flooding during rapid snow melt or heavy rains.

Land ownership along Little Dry Creek is 100% private. There is some state land within the drainage, but not along the main stream. A county road and numerous ranch roads provide access to most of the stream. Grazing and hunting are the major land uses within the drainage.

**GAME FISH PRESENT:** Channel catfish, walleye

**FISHERY:**

Permanent resident fish populations in Little Dry Creek are limited due to the intermittent flow of this stream, but pools apparently can sustain some species including channel catfish, white suckers and carp.

In spite of the ephemeral nature of this stream, sampling with larval fish nets and beach seines in 1979, demonstrated that Little Dry Creek is a crucial spawning and nursery area for many species of fish residing in Fort Peck Reservoir. Adult walleye ascend the first 22 miles of Big Dry Creek and then 8 miles of Little Dry Creek to spawn on gravel bars when spring flows are sufficient to allow passage from Fort Peck Reservoir. Spring runoff in the drainage is seldom of sufficient magnitude, or of correct timing, to coincide with the annual spring walleye spawning run. However, in years when walleye are able to ascend the stream, as occurred in 1978 and 1979, a good walleye year-class is produced. Walleye

eggs, larvae and young-of-the-year fingerlings were collected in the lower reaches of the stream.

Seining in Little Dry Creek also produced young-of-the-year channel catfish, white and shorthead redhorse suckers, river carpsuckers and carp. Several minnow species were also found.

#### WILDLIFE:

Big game animals found in the Little Dry Creek drainage include antelope and mule deer. Sharp-tailed grouse, sage grouse and Hungarian partridge are the resident game birds. There is some waterfowl use on the stream throughout the ice-free periods.

#### WETTED PERIMETER:

Attempts to utilize the wetted perimeter method on Little Dry Creek were unsuccessful. Four transects were established approximately 400 yards downstream from the highway 200 bridge and stage data were collected at flows of 1.6 and 33.4 cfs. Because of the stream's low gradient and shifting channel condition during runoff events, the data were not usable. The wetted perimeter method is not always adaptable to prairie stream conditions.

#### WHY FLOW IS NECESSARY:

The requested spring flows are necessary to provide spawning flows for walleye during years when runoff coincides with the spawning run from Fort Peck Reservoir. The flows requested during the remainder of the year are necessary to provide some flow between pools in the creek channel during the summer and fall to help maintain resident fish populations and young-of-the-year migratory game fish rearing in the stream. These flows will also help protect the habitat for those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

#### FLOW REQUEST:

March 15 - March 31	--	110 cfs	(3,491 A.F.)
April 1 - April 30	--	42 cfs	(2,499 A.F.)
May 1 - May 31	--	17 cfs	(1,045 A.F.)
June 1 - October 31	--	3.5 cfs	(1,062 A.F.)

8,097 A.F./yr.

The basis for the requested flows is the Water Availability Study prepared by the USGS for this site (see Appendix A in Volume 1). Mean monthly flows are being requested from March 15 through May 31 to provide reasonably high flows during the walleye spawning period. The 50th percentile flow is being requested for the remainder of the summer and fall. This flow will be available 5 out of 10 years on the average and should be high enough to maintain some flow between pools to maintain resident and rearing migratory fish.



**LAKE NAME:** Bean Lake

**LOCATION:** Sec. 18C and 19B, T18N, R6W; Sec. 13D and 24A, T18N, R7W

**DESCRIPTION OF THE LAKE:**

Bean Lake is a natural lake located 15 miles southwest of Augusta in Lewis and Clark County (Figure 3-100). Maximum depth is 32 feet and the volume is about 2,151 acre-feet. Lake levels are maintained by groundwater seepage from the Dearborn Canal and runoff. A man-made overflow to the Dearborn River passes water only during extremely wet years. The lake lies at an elevation of approximately 4,555 feet. Water visibility is about 10 feet during ice cover but is considerably less when plankton blooms occur in the summer. Bean Lake is located in the foothills along the east front of the Rocky Mountains. Timber-covered slopes occur to the west and south of the lake. Forest fires during 1988 burned portions of adjacent drainages.

DFWP has planted Bean Lake since 1933. Due to landowner-sportsmen conflicts, the lake was periodically closed to fishing. To ease these problems, DFWP purchased 16.33 acres from Wallace Bean on February 6, 1964. The purchased site was then developed for fishing, boating and picnicking. The access site is divided into two areas with boat access and sanitary facilities available at each area. Eight picnic tables and several parking areas are distributed throughout the site. Parks visitation to Bean Lake was 9,200 visitors in 1982, 8,500 in 1984, 10,400 in 1986 and 8,200 in 1988. Ownership of the shoreline is approximately 75% private and 25% state (DFWP). Lands outside the access site are all privately owned and used for cattle grazing. Access to the lake is by county road #434 between Augusta and state highway #200.

**FISHERY:**

Bean Lake is currently managed for rainbow trout. Stocking records indicate that DFWP planted silver salmon and rainbow trout from 1933 to 1935. Rainbow trout were again stocked annually from 1951 to 1957 and silver salmon were also planted from 1951 to 1954. Fish were not stocked in Bean Lake from 1958 to 1963 due to access difficulties mentioned earlier. From 1964 to the present, rainbow trout have been stocked and produce an excellent fishery. A total of 40,000 fingerling fish are stocked annually.

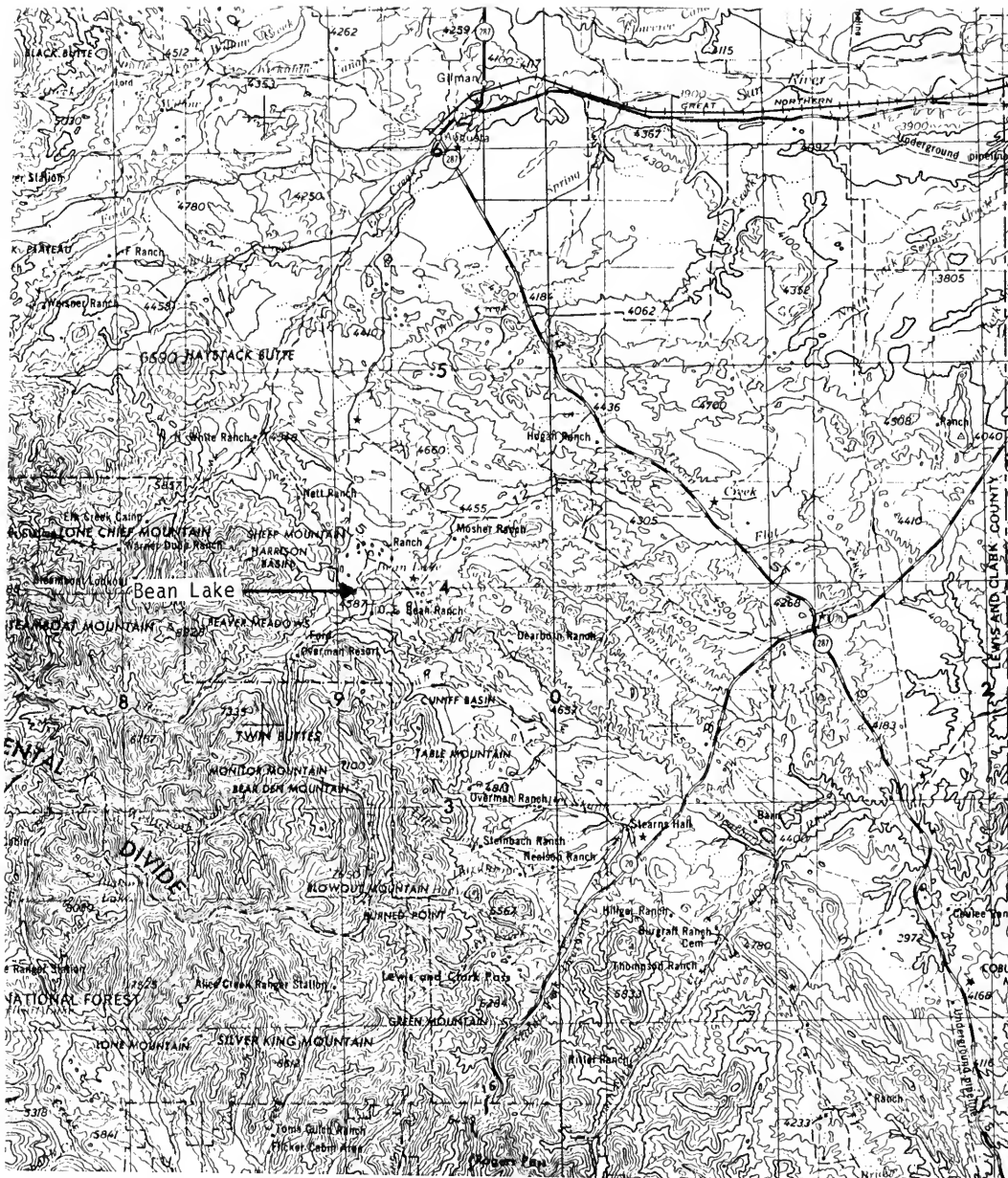


Figure 3-100. Location map for Bean Lake.

After one growing season in the lake, trout average 12-13 inches in total length and weigh from 0.75 to 1.00 pound. Second year growth of these fish increases to about 15-17 inches and 1.40 to 2.25 pounds. Fishermen periodically catch older trout in excess of 4 pounds. Catch rates for the 1986-87 season averaged 0.8 fish/hour, a satisfactory rate of harvest. Other fish found in Bean Lake include a few fathead chubs and white suckers.

Bean Lake is one of the best trout fisheries in the Great Falls area. The majority of the anglers come from within a 75-mile radius, however, approximately 10% are non-resident. Fishing pressure determined by the 1982-86 statewide mail survey was between 5,100 and 10,400 angler-days and averaged 7,200 angler-days per year (McFarland 1989).

#### **WILDLIFE:**

Big game animals found in the surrounding area include elk, mule deer, white-tailed deer and black bear. The grizzly bear, a threatened species under federal law, occasionally uses the area during spring and fall. Upland birds include sharp-tailed grouse and Hungarian partridge. Mountain grouse are found on nearby timbered slopes. A variety of waterfowl and raptors also use the area.

#### **METHODS:**

The volume of Bean Lake was determined by measurements made in 1959. A map of the lake was made by tracing the shoreline from an aerial photo. Echogram soundings were made in the field on transect lines across the lake. Contour lines were then drawn on the base map at corresponding depth readings (Figure 3-101). A computerized planimeter was used to determine the area (acres) at each contour interval. Welch's (1948) formula was then used to determine the volume between contours and the total volume of the lake, which is 2,150.6 acre-feet.

Monthly measurements of lake surface levels were made by DFWP from June 17, 1975 to September 29, 1978. The lake has no surface inflow or outflow. Based on these measurements, the maximum annual evaporation and groundwater loss during the period was 2.49 feet per acre or 498 acre-feet (200 acres x 2.49 feet). The requested level was determined by adding the calculated lake volume of 2,150.6 acre-feet and the water loss of 498 acre-feet. The total is 2,648.6 acre-feet.

#### **WATER LEVEL REQUEST:**

January 1-December 31 -- 2,648.6 A.F./yr.

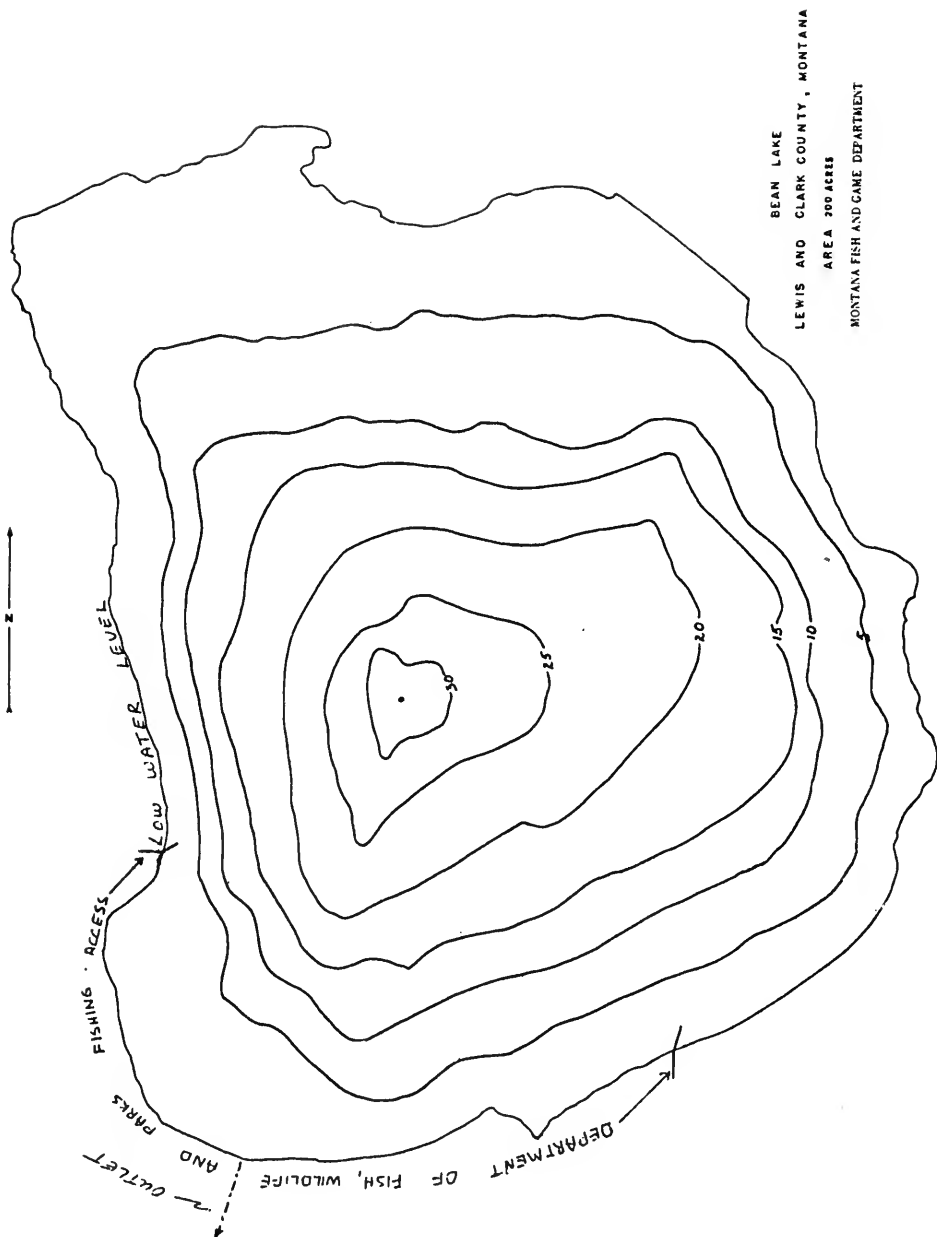


Figure 3-101. Contour map of Bean Lake.

**LAKE NAME:** Antelope Butte Swamp

**LOCATION:** North 1/2 Sec. 28, T26N, R8W

**DESCRIPTION OF THE AREA:**

The Blackleaf Wildlife Management Area (WMA), of which the Antelope Butte Swamp is a part, comprises 10,430 acres of deeded and leased lands lying approximately 14 miles west of Bynum in Teton County. The deeded lands were purchased by DFWP in 1979. The area lies in the foothills east of the Continental Divide and is overlooked by the Rocky Mountains (Figure 3-102). Topography varies from flat, sub-irrigated meadows and marshes, to rolling hills, to high timbered and rocky outcrops on the west boundary of the property. Several small streams and tributaries dissect the landscape from west to east. Topography varies from 4,300 to 6,700 feet in elevation.

Land ownership dates back to the late 1800s and early 1900s after unreserved Indian lands were opened to settlement. The railroad into Choteau was completed in 1914 and with it came numerous hardy individuals willing to take a chance with farming and ranching in Montana.

A variety of land uses has occurred in the past. The primary use of the area continues to be livestock ranching. Farming of small land tracts occurred in the immediate vicinity but this activity was limited and of minor importance. A portion of the Blackleaf WMA was once a game and bird preserve known as the "Blackleaf Preserve" which was created in 1921 by the Montana Legislature. It was abandoned in 1954. The area borders the Lewis and Clark National Forest and Bureau of Land Management lands.

Several small ditches from tributaries to Blackleaf, Rinker, and Muddy creeks carry water to flood-irrigated hay meadows. Ostle Reservoir is a 47-acre impoundment which stores water for use on neighboring irrigated lands. Water is supplied to the reservoir via Antelope Butte Swamp and Rinker Creek. Water supplies for irrigation depend largely on spring runoff. Flows are sharply reduced after major portions of the winter snowpack have melted in the adjacent foothills and mountains. Several year-round springs supply water for livestock and wildlife.

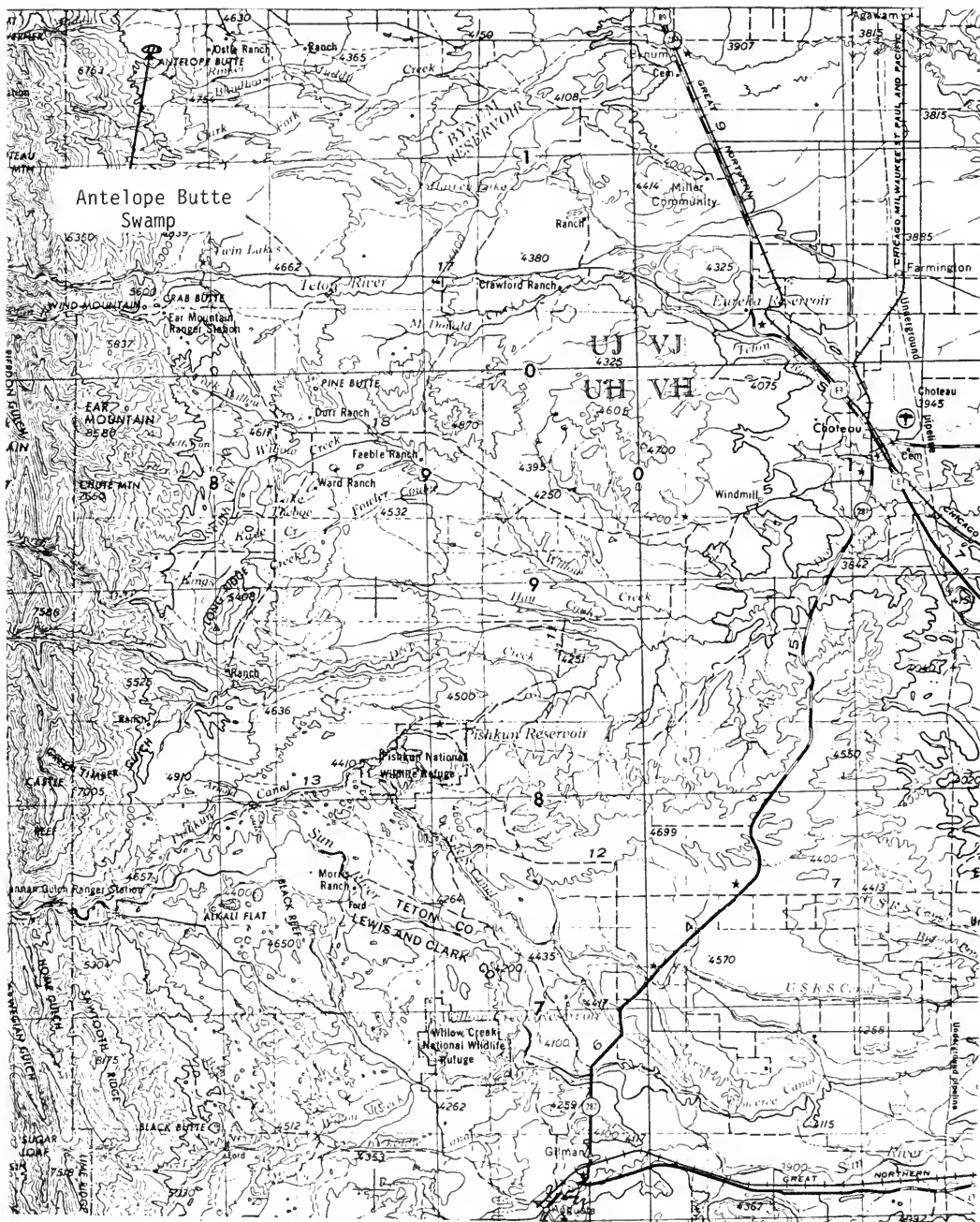


Figure 3-102. Location map for Antelope Butte Swamp.

Antelope Butte Swamp is a perennial wetland area of approximately 240 acres fed by No-Name Creek and a diversion from Muddy Creek (Figure 3-103). Wetlands of this type are also commonly fed by underground flow due to the porosity of glacial gravels which overlay older soils. The area is bordered on the south and west by wet meadow grasslands interspersed with stands of aspens and willows. The interior of the wetland is mostly sedge-rush dominated communities within standing water which creates a mosaic throughout the swamp. Vegetation appears in clumps or small islands surrounded by water from 1-18 inches deep. Beavers have created numerous ponds on the western perimeter which have water up to 5 feet deep. The north edge of the swamp abruptly ends in a limber pine-aspen dominated gravel terrace.

Water which drains from the swamp's southeast corner can be diverted into a ditch that feeds Ostle Reservoir, or it can be allowed to follow a shallow ditch that leads to hay meadows east of the swamp. However, most of the water leaving the swamp is first diverted into Ostle Reservoir and then used on those same meadows to the east.

#### **FISHERY:**

Local anglers state that Antelope Butte Swamp contains brook trout but this has not been documented by DFWP. White suckers and an as yet unidentified species of chub are year-round residents. Little or no fishing occurs in the swamp, at least in recent years.

#### **WILDLIFE:**

Wildlife species present on the WMA at least a portion of the year include elk, mule deer, white-tailed deer, black bear, grizzly bear (a threatened species under Federal law), mountain goat, bighorn sheep, blue grouse, ruffed grouse, spruce grouse, sharp-tailed grouse, bobcat, coyote, lynx, badger, mink, muskrat and beaver. Numerous songbirds, raptors, and other smaller varieties of mammals and birds abound in the marsh and productive meadows as well as in the heavy cover of limber pine, aspen, willow and bunchgrass communities.

Management of the Blackleaf WMA centers around elk, bear and deer populations. High quality winter and spring habitat is essential to the survival of these animals. The Blackleaf WMA supplies this necessary habitat component. Grass species such as rough fescue provide winter and spring forage for elk and deer. Aspen, willow and pine communities offer thermal and





escape cover for all three species. The lush wetland forbes and grasses growing in and around the Antelope Butte Swamp provide forage for black and grizzly bears during the late spring and early summer months. White-tailed deer use the marsh intensively for cover and forage during all seasons of the year. Mule deer seek out shelter from severe winds during winter months and are frequently observed feeding in and around the interior of the area during early spring months. Elk have been observed feeding and resting in the heavy cover of willows and aspens.

Hunters have harvested mule deer, white-tailed deer, elk, grouse and black bear in and adjacent to the swamp. This wetland area serves as a focal point for public recreation during peak use periods in the summer and fall. Bird watchers, hikers, photographers and nature-lovers have learned that the best scenery and wildlife possibilities are around highly diverse vegetation types such as are found around Antelope Butte Swamp.

#### **WHY WATER LEVEL IS NECESSARY:**

Antelope Butte Swamp is an integral part of the Blackleaf WMA. Bears, deer, and elk use the wetland on a year-round basis for forage and cover. Maintenance of adequate water levels helps to keep the critical vegetative mosaic intact. Less water means a shift toward a more mesic environment (such as the limber pine/savannah type habitat occurring to the north) and a loss of valuable forage and cover. The importance of the WMA as a winter and spring range for these species is closely connected to the relative health of its wetlands.

#### **METHOD:**

Antelope Butte Swamp covers approximately 240 acres and contains about 100 acres of open water. Water depths vary from 5 feet in several beaver dams to a few inches in marshy areas. Average depth of standing water is about 1 foot. Therefore, the swamp contains about 100 acre-feet of water. Average evaporation in the area is about 36 inches per acre per year. DFWP is requesting 100 acre-feet of storage in the swamp plus 360 acre-feet for evaporation which totals 460 acre-feet of water per year.

#### **WATER LEVEL REQUEST:**

January 1-December 31 -- 460 A.F./yr.



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